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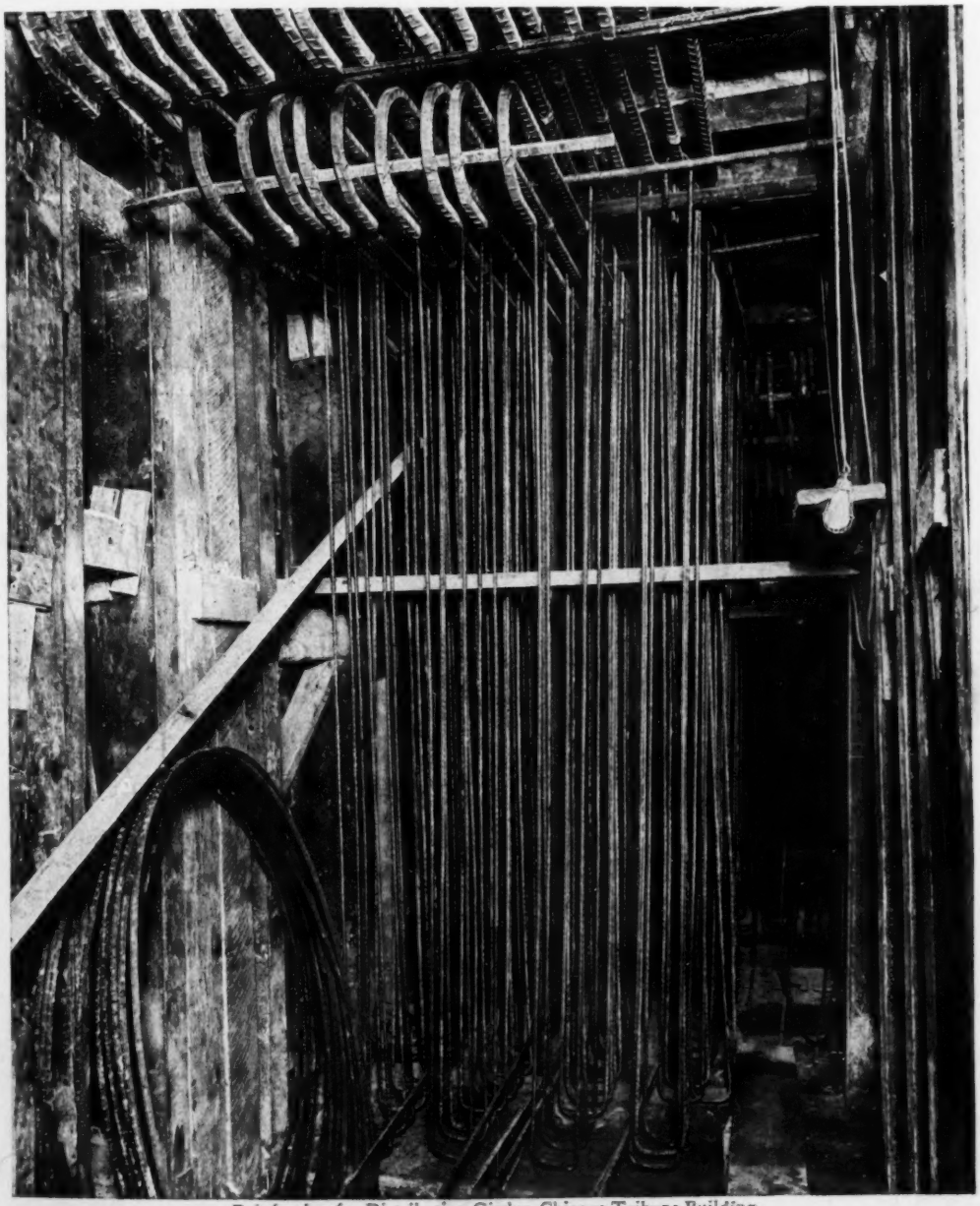

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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An Economic Settlement

PUBLIC and authoritative acknowledgment was made last week to the service that industrial leaders can give government and through the government the people. Both Secretary Hughes and Secretary Hoover, in their tribute to Owen D. Young, abstracted on another page of this issue, made it clear that the Dawes commission, studying the problem of world adjustment as economists and industrialists and not as diplomats or statesmen managed to evolve a *modus operandi* which while not yet assuredly successful certainly gives more promise of success than anything that the chancelleries were able to devise through five years of post war negotiation. This is a distinctly American contribution to world peace, a later day "shirt sleeves diplomacy," of which Americans may be proud. If this nation can slowly impress upon the world the necessity of adjusting world relations upon the same equities that obtain in private business and not upon the ancient, though now generally veiled, doctrine that might makes right, it will have played another important rôle in history.

A Unique Leader

SAMUEL GOMPERS grew in stature with the organization he personified. Indeed, he was the organization and he lived to confute his and his organization's enemies who saw in it the prototype of what since has come to be known as bolshevism. But Gompers fought bolshevism, under that or other names, all his life and his keen sense of political strategy combined with his very real sympathy with American ideals as the best medium in which to foster the interests of labor, were major factors in putting the American labor movement on the firm base it now occupies. Only once in his late years did he make a serious mistake—and that one made a President. For it was Gompers' ill-advised defense of the Boston police strike that gave Governor Coolidge the opportunity to pen that laconic note that fixed his personality in the minds of the American people. Labor will have a hard time to find a new leader who combines so ardent a love of its aims with so shrewd an understanding of the American temper.

Apprenticeship Made Popular

REVIVING the interest in craftsmanship is an uphill job in the building industry, but when seriously undertaken it can be done. The report of the apprenticeship commission of the New York Building Congress shows this. Organized two years ago with representation from both the unions and the building employers this commission is now reporting real progress. Through the co-operation of the New York City schools trade education is being given at night to the registered apprentices, who are assured of position and pay, during good behavior, by the employer, and of sympathetic attention by the labor union. In the two years seven trades have opened schools under the supervision of the commission and the numbers of apprentices have materially increased, in carpentry by 200 per cent, in bricklaying by 300 per cent and in painting, concrete work and plastering 100 per cent. Every one who has observed the work of the commission and who has known the difficulties of getting and keeping apprentices, is encouraged by the results of the New York effort. But that effort has meant steady attention by a number of men and the cordial co-operation of the employer and the union. Knowing the serious shortage in the skilled building trades, every man in the building industry should be willing to do similar work or offer similar co-operation in his own community.

Built on Sand

WHEN the Laguna Dam across the Colorado was built fifteen years ago there was not too much confidence in this country as to the ultimate stability of this type of broad bottom overflow weir founded on porous sand. In India the porous foundation dam had long been known, and the theory of the reduction of hydraulic pressure by lengthening the flow line beneath the dam had been well developed. Our practice leaned toward the necessity of a solid bottom, or at least a complete cutoff to solid bottom. The Laguna Dam was built, however, on the sugar-like sand of the Colorado and the river allowed to flow over it in times of high water. That was fifteen years ago, and the dam still stands, a testimonial to the effectiveness of the theory of its design. And what is more, as the article in this issue shows, it has survived a very considerable test in the way of downstream undermining due to the cut back below the dam. The experience at Laguna shows that the principle of the porous foundation dam works out in practice.

Hope Ahead

RESTORATION of unified management in the administration of the Western reclamation projects has just been announced. It is a welcome piece of news. The new order brings to an end a bad state of affairs that was initiated last year when the previously existing unified management was broken up, and a many-headed plan of administration was substituted. Only last week W. W. DeBerard of the staff of this journal reported from the field that the system of divided control was not working well, in fact that it was one of the worst features of the situation in the operation of the present projects. The former change of system was made by Secretary Work avowedly as a move in his campaign against the engineers of the Reclamation Service, but it reflected also the animus of the repudiationists on the reclamation projects, who saw in the integrity of the engineering organization an obstacle to ultimate cancellation of their debts to the government. The axiom that efficiency requires unity

of management was disregarded in setting up the new system. The year's experience, however, has made it plain that the system was bound to do harm. How much harm the system has done to the projects and the farmers is not readily determinable, especially as the subdivision of management was to a large extent ignored even by the project farmers who were supposed to be favored by it. But it is certain that serious harm was done within the reclamation organization itself. It may be hoped that the new order, restoring unified control, will work in the opposite direction and will again establish the teamwork and spirit of energetic devotion on which the Reclamation Service built its distinguished career.

Road Relocation Profits

PENNSYLVANIA during the last two years has set out seriously to study the possibilities of reducing mileages by relocation of state highways. So far the state highway department has made relocations on through routes which shorten them an aggregate of 100 miles. While at first thought the accomplishment may not impress one as great it looms up larger as it is given study. Pennsylvania is an old commonwealth and its highway travel routes have been well fixed by custom. Moreover the state lawmakers in selecting and denominating certain of these travel routes as state roads designated the principal places connected by any highway. It is only between these named places, then, that the highway department has powers of relocation. Here its engineers have done the shortening in numerous small amounts scarcely ever exceeding a mile, which make up the total 100 miles. In the increased light of the limitations, then, the aggregate reduction of distance takes on greater comparative importance. In dollars and cents its significance is rather stupendous. Indeed the engineers of the highway department, on the basis of 1,000 vehicles a day, estimate the saving in investment, up-keep and operating expenses to be $4,910,000 a year. On even a much smaller showing of gain all the expense that the Pennsylvania road department has put into its division for revising highway location would appear insignificant.

Bold Bridges

THE Pittsburgh project for the reconstruction of the three downtown bridges over the Allegheny River departs sharply from familiar ways of thinking and strikes out into a new field. Building three closely adjacent bridges as a single group undertaking is quite unprecedented in city construction work. Adopting the same design for all three, so that they will be identical to all outward appearance, is even more iconoclastic. To make the whole case still more surprising,, the design selected is the first introduction into American practice of the self-anchoring suspension bridge. The innovation well deserves discussion, and we trust it will receive it. Looked at from the structural viewpoint of bridge engineering, the design is a logical development. It represents an efficient embodiment of the principle of compound truss construction, and, while bridge development in this country has for many years been wholly along the line of simple structures and has ignored and even cried down the compound type, the recent trend has been toward some recognition of the merits of the latter. In the present case the designers evidently looked beyond the bounds of current practice in order to find an efficient adaptation to the conditions of their particular case. Before their work can be judged adequately, more information as to essential details of the proposed structures is necessary, and we trust that such information may be made available soon. In the meantime it is important to note that the basis for the choice of the suspension type for the three bridges was an esthetic requirement imposed by the local art commission. Apparently this body did not stop to consider whether suspension bridges would be suited to the physical conditions at the sites, but based its dictum wholly on esthetic notions. The resulting design, therefore, to be considered not as the engineers' free choice but as their response to the demand that suspension bridges be built. The question of whether suspension bridges *should* be built at these particular sites is a wholly separate one; but perhaps it is the most important question of the case.

The Anti-Power Complex

IN THE current discussions in Congress on the disposition of Muscle Shoals the delusion persists that there is something innately inimical to the welfare of the people in the production of power. The most scathing remark that a Southern senator can make is that some particular offer for the Shoals development is "merely a scheme to develop power." Where does this distorted view of power production come from? What quirk of mind is it that pictures power as something that benefits the producer alone, as though the energy stored up in the flowing water is in some way, in the process of conversion to electrical units, diverted solely to the profit of those whose capital and thinking is responsible for the conversion.

This state of mind is not confined to Southern congressmen who have for so many years seen Muscle Shoals as the apotheosis of the South that they can no longer think straight on it. It is, in the language of the new psychology, a widespread complex that may seriously retard the proper utilization of our rivers. It is a complex that has taken lodgment in the minds of many of our politicians. A governor of New York and an ex-senator from California are afflicted with it—and it is the pet possession of most of our so-called intelligentsia.

Those who have this complex see in any proposal to utilize the potentiality of flowing water a conspiracy to deprive the people of their God-given rights and in any suggestion of the private development of that water power the first step toward corporate robbery. Underneath that complex lies, known or unknown to its possessor, the appreciation of what power means to the world and the knowledge of how commanding a hold on humanity the owner of power will eventually have. But the manifestation of that appreciation and knowledge is warped into an unreasoning antagonism toward those who would attempt to make the power available to man. This fear of a future domination has become so strong as to destroy all confidence in the power of the law to prevent or even to modify such control. They see in all power proposals the octupus of monopoly thrusting out its first tentacles. No power at all or the doubtful expedient of government owned power is their timid defense against this ominous future.

At Muscle Shoals, for instance, there are those who honestly, however wrongly, think that nitrate production there is going materially to reduce the price of

fertilizer to the farmer, regardless of the fact that nitrates make up only a small part of fertilizer and that the nitrates producable at Muscle Shoals are only a small part of the total amount of that chemical needed in the fertilizer industry. Such a position is understandable, but there are at least as many whose advocacy of nitrate development is only a screen behind which hides a selfish desire to upbuild a local industry in one section of one small river valley or who are possessed by this curious antagonism to the production of power in large blocks for long distance distribution.

Potential power exists at Muscle Shoals in large quantity, when the whole river stage is developed, and the benefits of that power will flow out over the entire South, blessing its communities probably far more than could any cheaper nitrate bless them and certainly more than could the cheaper production of automobiles. This blessing is conferred by power regardless of who is the agent producing it. The private company that owns or operates the plant and distributes the energy is merely acting as an intermediary, under government control, between the power and the people and for that mediation it receives a profit. If that profit is unreasonable, as these crusaders against power seem to think it is bound to be, the remedy, lies in the law of control, not in the prevention of power distribution.

This condition has its earlier analogy in the waterway enthusiasts, to whom economics or experience are as chaff before the wind and who want only to build waterways and more waterways anywhere or anyhow, satisfied that merely by so doing the cost of living will immediately fall. Well founded arguments against certain forms of power development or in favor of certain forms of waterway development deserve the engineer's earnest consideration—and if proved, his approval—but this newer form of general antagonism to any private proposal to generate power for wide distribution has reached almost a state of mental disease and must be treated as such.

Competitive Bidding

AN UNPLEASANT shock is given to established views of the relation between the engineer and his client by the recent invitation by the Port of New York Authority for proposals to carry out certain important bridge designing. The letter of invitation is published in full on page 991 of this issue. Its meaning is plain. It calls for bids on price and time of delivery of expert engineering services—services involving a very high type of specialized engineering skill and trained judgment—in precisely the way that one would ask for price and time of delivery on a ton of coal or a thousand of brick. For the first time, thus, a responsible and well informed public authority has resorted to the bidding system of selecting a professional man to direct the expenditure of large sums of public money.

No explanation has been given out by the Port Authority of its reasons for asking bids. Nor did the public announcement of the selection of an engineer (Dr. J. A. L. Waddell) include any reference to the invitation or to the receipt of proposals in response thereto. The situation is fairly clear from the letter itself, however. The invitation does not inquire as to qualifications, and was sent only to a small list of engineers, presumably selected in advance for their known qualifications. The proposals requested evidently relate to fees. It is known that the Port Authority had limited funds for the preparation of the designs wanted, and with a view to fitting the engineer's fee to its purse it proceeded to shop around for engineering services.

Bidding and asking for bids are not new to engineers. They have for some years been a vexatious problem in professional life. Boards of aldermen of small communities or county commissioners, unfamiliar with the requirements of engineering work or the qualifications of engineers, have frequently, in recent times, tried to solve the difficulty of selecting an engineering specialist for a new water-works or a bridge by receiving bids from various engineers, or even by calling for bids in public advertisements. But important and responsible public bodies, or for that matter private corporations, have never, to our knowledge, followed such a course in retaining an engineer—nor in retaining a lawyer to conduct an important case at law. We doubt whether the Port Authority would think of defending a lawsuit on which its existence depends, or in which $10,000,000 is at stake, through counsel retained as the result of competitive bidding.

One can in a measure sympathize with the attitude of small-town officials faced with the responsibility of engaging a specialist to carry out a piece of public construction beyond the range of the regular staff. Such officials lack knowledge of what qualifications are required by the problem in hand, or how to weigh the qualifications of the available engineers. They do not know what fees are proper, and wish to pay as little as possible. Commonly they fail to realize that the services to be performed are not capable of such definite statement that equal performance by any candidate who might be selected is assured.

The case of the Port Authority is altogether different. Located in the metropolis of the country, having able and widely informed engineers on its staff and every conceivable opportunity for securing supplementary professional advice, the Port Authority had no such reasons of ignorance for its action. Moreover, it was in the same position as any corporation dependent for its financing on market credit based on the soundness of its enterprises. What confidence could a corporation expect in the money market if it proposed to entrust an investment of $10,000,000 to engineers selected on a price basis, or if it even approached the problem of securing the desired technical skill from the standpoint of saving as much fee as possible?

The preceding is in no way intended as a reflection on Dr. Waddell, whose long career of experience in bridge work, even apart from his recognized professional eminence, is full assurance that he is qualified for the design of the bridges in question. Nor do we know that Dr. Waddell's selection was in any way due to the invitation for proposals, although we understand that he was one of the small list of engineers to whom the invitation was sent. Our protest lies solely against the action of the Port Authority and against its attitude toward the problem before it.

In itself the action is mainly of local interest, and even in this aspect it might be dismissed with a casual word of comment, since it will probably affect the interests of the New York region but little. But in its influence on the engineering profession and on principles of proper conduct it is of critical importance. It places the question of competitive bidding squarely before the professional conscience.

Underpinning Printing Plant for New Deep Foundations

Large Newspaper Presses Carried by Jacks and Blocking While Wells for Concrete Piers Are Sunk 120 Ft. Through Clay to Rock—Deep Sub-Basements for Lofty Office Building

EXCEPTIONALLY difficult and delicate shoring and underpinning have been accomplished in supporting the building which contains the printing plant of the Chicago *Tribune* while sinking wells under part of the pressroom for additional foundation piers to carry the steel framing of the adjacent lofty Tribune Tower office building, now under construction. For the printing plant there is a five- and seven-story brick and steel building on the east part of the site, with the tower at the west and fronting on Michigan and Austin Aves. The basement and parts of the sub-basements, however, extend to the curb lines of the two streets and across the alley on the north side. The tower, about 100x136 ft. in plan, has eight stories below the first floor level at the upper deck of Michigan Ave., the lowest, for the ash room, being 41½ ft. below water level in the Chicago River and 75 ft. below the first floor. Rock is found at 110 to 120 ft. below the river level and is overlaid by blue clay mainly.

The new foundation and substructure work consisted in sinking fifty-one wells or caissons to rock for foundation piers supporting the west end of the old building, the press extension and the 36-story tower. This required the removal of some old foundations and the construction of new piers under them. The presses and various mechanical plants were kept in uninterrupted operation. In addition, it involved the trenching and building of retaining walls, some of which extend to 45 ft. below water level in the river, the building of great continuous girders under the presses and the erection of 2,800 tons of structural steel, together with excavation of 30,000 cu.yd. for the basement and the cores of the sub-basements. There were also eighteen piers sunk to hardpan, which with eight piers previously sunk to rock, made a total of seventy-seven foundation piers. When the printing plant was erected five years ago, eight foundation piers or caissons were put down under the pressroom as supports for the future tower, but later changes in the design made it necessary to sink wells for additional piers and to build some large continuous girders to distribute the loads over the new and old piers. The sinking of the well for a new foundation pier under a wall is shown in Fig. 1.

Supporting the Presses—In the north bay of the basement and the first story of the old building are units 1 to 17 of a longitudinal series of press machines, while units 18 to 25 are housed in a two-story addition which extends west across part of the site for the tower. These presses, about 230 ft. long over-all, constitute practically one huge machine and are in operation during a large part of each day. Interference with their regular operation was out of the question, while the press manufacturers stated that settlement of even one-thousandth of an inch might cause serious trouble. The seven-story building has its column footings carried on timber piles, while its two-story pressroom extension is supported on the eight piers mentioned above. The presses have three different types of support. In the seven-story building they are carried on spread foundations resting on the clay and independent of all pile supports. At the west wall they are carried by reinforced-concrete girders, seated on the pile caps of the wall columns. In the two-story extension they are carried by concrete girders supported on the eight foundation piers. A section of the new and old foundations, with the deep basement floors, is shown in Fig. 2.

Alterations to the foundations of the west wall of the seven-story building constituted the first step. In this wall the south four columns, each carrying about

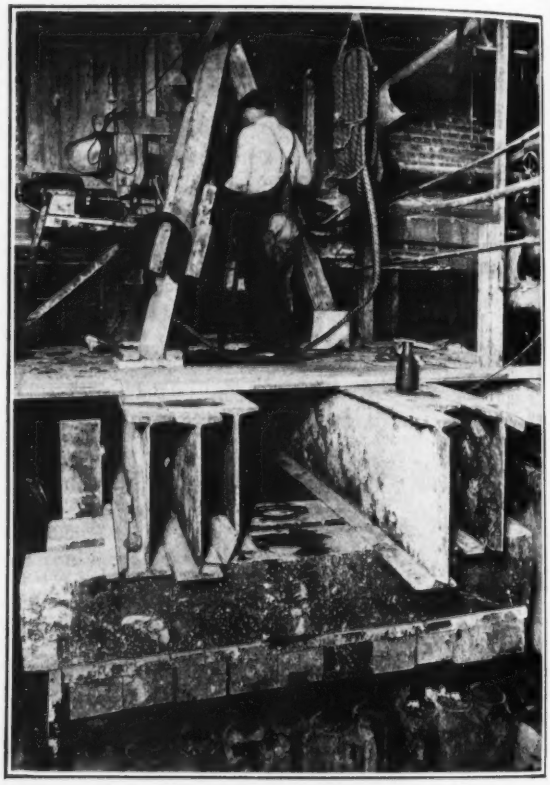


FIG. 1—SINKING FOUNDATION PIER UNDER OLD WALL

The man is handling the bucket rope of a deep well by means of an electric winch, the motor of which is seen at the left of the tripod carrying the sheave over the well.

300 tons, were shored by placing a billet through the column and supported by steel beams carried on timber cribs built on heavy timber platforms on the clay soil, as shown in Fig. 3. The beams were jacked slightly to take the column load from the footings, which were then removed while foundation wells were sunk under the columns, as shown. Needle beams carrying a wall column are shown in Fig. 1, with a man handling the bucket rope of the well; this rope is coiled on the winch of an electric hoist whose motor and shaft are shown at the left. Each of these new piers is large enough to carry two columns; one for the building and one for the tower. All wood piles within this area were removed as the wells were excavated. This part of the shoring work also required the shifting of a 150-ft. temporary steel smokestack built against the outside of the west wall. For this operation, the fires were

drawn for a few hours while the stack was moved 3½ ft. on rollers and new connections were put in.

The sixth column, at the northwest corner of the old building, was shored on steel needle beams placed under the old pile caps and resting on 25-ton steel jacks on wooden cribbing on the clay. With the column thus supported, Fig. 4, the new well was sunk and concreted, and the piles in way of the distributing girder built upon the pier were cut away to permit of pouring the concrete for this girder. The columns of the next row inside the building were shored up with wing brackets temporarily attached and supported by 25-ton steel screw jacks with cut threads, the jacks being seated on short beams bearing directly on the pile caps, as shown in Fig. 3. In this way, the columns could be maintained at proper level, while the piles settled owing to the excavation of the wells under the wall. In sinking these wells, it was necessary to cut away the 50-ft. piles which supported the old footing, some of the wells including six or seven piles. They were cut off in lengths of 3 to 4 ft. as the wells were excavated. Piers were not built under the columns of this second row, but, after settlement had ceased, steel plates were driven under the old base plates. At the third row of columns the settlement was less than ½ in. and they were not shored.

Work was then undertaken at the presses in the two-story extension and the west end of the seven-story building. Since the press manufacturers had stated that a settlement of one-thousandth of an inch could not be allowed if the presses were to be kept in operation, it was considered advisable not to disconnect their anchorages to the spread footing and reinforced-concrete girders, and a sufficient area of this footing was placed upon blocking with 10-ton house-raising jack-screws, as shown at the right in Fig. 5. The footing was left supported on jacks for three months after settlement appeared to have ceased.

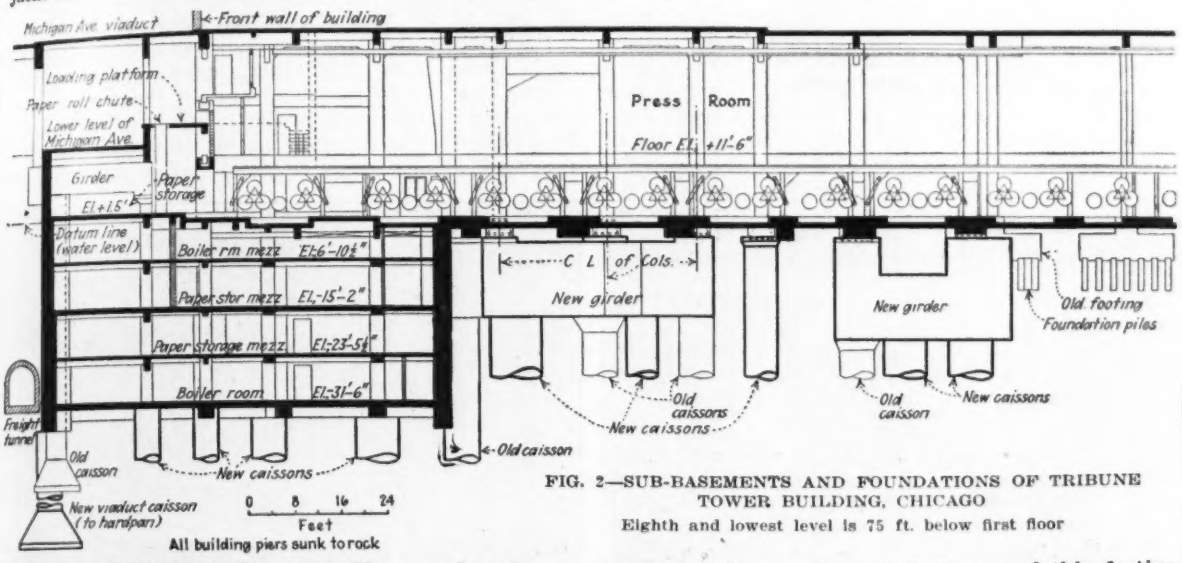


FIG. 2—SUB-BASEMENTS AND FOUNDATIONS OF TRIBUNE TOWER BUILDING, CHICAGO
Eighth and lowest level is 75 ft. below first floor

Control of Jacks—With the machinery thus supported, the necessary foundation wells were sunk. The usual soil settlement due to such excavations was anticipated; and in order to enable prompt adjustment of the jacks to take up any local movement, two parties of engineers took level readings on various parts of the machines throughout the day, and also for periods before and after such major operations as cutting out sections of existing piers, digging large foundation wells on the new site and digging wells close to the presses. In this work, the jacks were located to control certain points; the workmen were shown the point under observation and instructed to take a quarter-turn on the screw (equivalent to a rise of 1/1000 in.) after which a reading was taken. At some points the soil was compressed more than 2 ft. in the loading and jacking.

At the fifth pile-bearing column from the south, no pier for a new column was required. As the pier girders here were all supported on the pile cap, it was necessary to tunnel under the cap, cutting out a section of the piles and installing jack-screws or blocking to support and adjust the press girders. Two tunnels about 6x8 ft. were driven, with crosscuts at the piers. Excavated material was hoisted in buckets (Fig. 1) and removed by 1-yd. steel dump cars which also carried concrete to be dumped into the wells. All new piers were left at least twenty-eight days before loading was put upon them.

Cutting Through Old Piers—To provide for the new superstructure plans it was necessary to build additional piers and three large distributing girders, Fig. 2. For this work, a shaft was sunk at each end of the pier extension and from these shafts was driven a

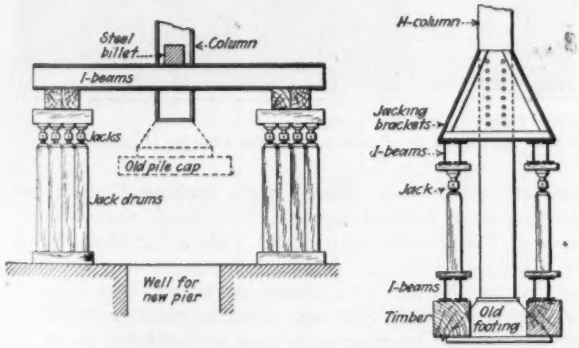


FIG. 3—SUPPORTING COLUMNS FOR NEW FOUNDATIONS
Left—Billet through column carries load. Right—Temporary wing brackets riveted to column for jacking.

tunnel large enough to accommodate the section of the girder. As existing piers came in the path of these girders, it was necessary to cut out a section 15 ft. high in six of these piers. To support the head of the pier and its column, thus separated from the foundation, niches were cut above and below the position of the part to be cut out, and in these were placed horizontal 12-in. H-beams. To deflect these beams in order to prevent settlement under load, they were forced apart by jack-screws on long drums or timbers so that 12x12-in. vertical struts of the required length could be placed between them. The jacks were then removed. As there is a heavy reinforced-concrete floor over the completed trench for this girder with some of the steel reinforcing in place.

With the excavation of the caissons, the presses in the two-story extension showed a tendency toward lateral movement southward. To resist this, they were shored horizontally by 16x16-in. timbers placed against the tops of the foundation piers, about 15 ft. apart, horizontally; these timbers were jacked against a transverse timber from which other timbers led to vertical timber mats 10x10 ft. placed against the face of the excavation at the south property line on Austin Ave. To distribute the pressure on the transverse timber, the head of each strut or shore had a steel T-head

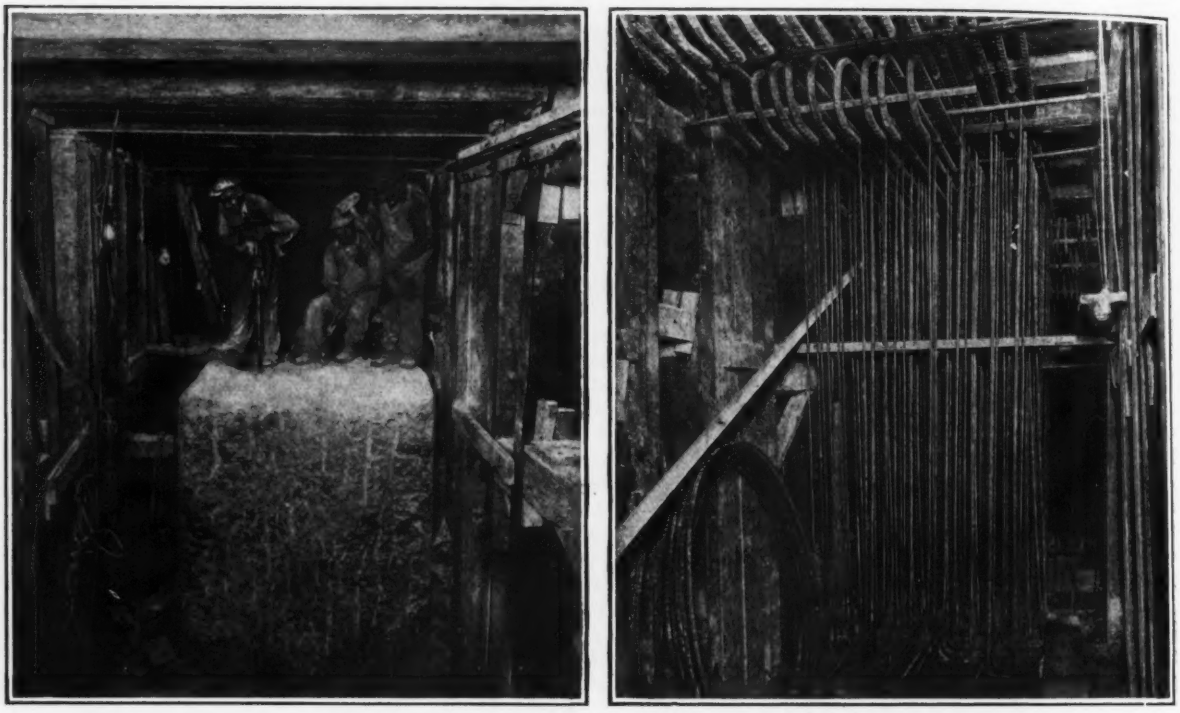


FIG. 4—BUILDING DISTRIBUTING GIRDER 15 FT. DEEP
Left—Cutting out section of old pier in line of girder; top of pier supported over trench. Right—Placing reinforcing steel for girder.

piers and girders, this was supported on jacks while the old piers were cut out and the new distributing girders were concreted.

Two of these distributing girders, 50 ft. 8 in. and 30 ft. 7 in. long, were built in trenches 11 ft. wide and 15 ft. deep. At the bottom of the trenches there was lateral pressure due to 35 ft. depth of earth, with the additional load from an adjacent garage, but with the great number of reinforcing rods required in the girder it was impossible to put any cross bracing in the trench within the space to be occupied by the girder. To meet this condition, 12-in. I-beams were placed vertically along the sides of the trench at intervals of about 24 in., with struts between their feet in grooves cut across the floor of the trench and with 10x10-in. struts between their heads above the level of the top girder. The 15-ft. sections of the piers obstructing the trench were then broken away with air drills and hand drills with sledges. Then the reinforcing steel was placed in the tunnel and the entire section was concreted. In Fig. 4, men are shown cutting away a foundation pier to make room for the distributing girder, 15 ft. deep; at the right is the against which were butted eight jacking timbers, the jacks being wedged against 3-ft. steel rails on the face of the transverse timber. This horizontal bracing is shown in Fig. 6. A maximum movement of about 1⅝ in. in the soil was taken up here. The pressure averaged probably 300 tons on each shore and was so great that the bearing rails were embedded 2 in. in the side of this timber.

Structural Operations—In the new substructure for the tower, Fig. 2, the largest foundation piers are 9½ ft. in diameter. Quicksand, water and boulders encountered in the lower 10 to 20 ft. of the wells made it necessary to do considerable pumping, to install widening-out sets in the lining, to drive the wood lagging in advance of excavation and to place horizontal cross bracing and jacks. In the usual stiff clay, the wells are excavated for lifts of 3 to 4 ft. and then lined with vertical tongued and grooved timbers held in place by ring braces. Some of the boulders were 3 ft. in diameter.

In building the deep sub-basements, the wells were first sunk and concreted; then the trenches for the outside retaining walls were excavated and the concrete

was placed. After the concrete had set, the steel columns were placed up to the level of the lower deck of Michigan Ave. (or main basement level) after which the steel framing was placed for the basement and sub-basement and the floors were concreted. Then the work proceeded downward, each sub-basement in turn being excavated, framed and concreted. Where the floors are built on the soil a drainage system was installed to prevent hydrostatic pressure. Water is drained into sumps and pumped to sewers. All steel is encased in concrete. Excavation was done by hand, the material being loaded in small motor trucks and dumped into cars of the Illinois Tunnel Co.'s freight tunnel system. Since the lowest excavation is below these tunnels, it was necessary to hoist material to the cars and to provide bracing in the tunnels. In constructing the lower sub-basements it was necessary to support and underpin the foundations of the viaduct forming the upper level of Michigan Ave., new wells being sunk to hardpan at about El. —75 (see Fig. 2) and surmounted by cantilever girders carrying the original viaduct foundations. During the work, Michigan Avenue had to be carried on temporary supports.

Practically all of the concrete was deposited by gravity chutes from a central tower on the Michigan Ave. side, this tower being built high enough to serve all parts of the site. In some of the lower floors, openings were left for chuting concrete into a portable hopper from which it was distributed by buggies, small steel dump cars and small motor trucks. In sinking the wells, about half of the work was done by winches

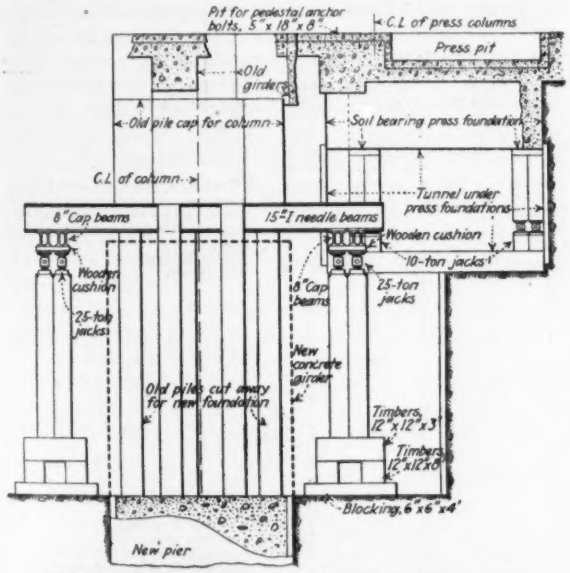


FIG. 5—UNDERPINNING OLD STRUCTURE AND PRESS FOUNDATION

or hoists operated in series by endless cables, while the other half was done by electric winches (Fig. 1). The latter were used in isolated places inaccessible by the cables. As a rule, a set of ten or more wells was started and served by one running cable; then if difficulties caused work to lag in one or two of these wells, the cable was transferred to a new set-up while an electric hoist was placed over each unfinished well. These electric hoists were used also over some of the deep trenches for retaining walls.

Engineers and Contractors—All the shoring, including the constant work of making observations and adjusting any incipient movement, was done by the L. P. Friestedt Co., under the direction of S. M. Gooder, superintendent. The shaft sinking and concreting for the new sub-structure was done by the K. C. Wieboldt

FIG. 6—HORIZONTAL BRACING HOLDS OLD PIERS IN LINE

Co., which had the general contract for the foundation of the Tribune Tower. Steel was erected by the Overland Construction Co. John M. Howells and Raymond M. Hood are the architects; H. J. Burt is consulting structural engineer. The foundations, shoring and substructure work cost about $1,600,000. Although this foundation and substructure work continued for about five months, there was no interference with the work of the presses, and no serious accidents occurred. Work was carried on continually by day and night and on Sundays.

Rhine-Danube-Main Canal Construction

Paris Correspondence

FROM Strasbourg it is reported that it will take 20 years to complete the Rhine-Danube-Main canal, which, according to the provisions of the Treaty of Versailles, is to be done by Germany at its own expense. This is due to the financial conditions of the Reich, which makes it impossible to push the work with the desired energy. It is hoped that the successful working of the Dawes Plan will induce outside capital to invest in the canal and make it possible to bring the work to an end. Incidentally, this canal work will furnish a large amount of hydraulic power, which will enable southern Bavaria to become a greater industrial factor. With what power will be available in northern Bavaria, it is estimated that there will be a total of 360,000 hp. available when the inland waterways and their accessory enterprises are completed. As a result of the development of hydro-electric power, it is estimated that the canal may pay for itself in a dozen years from the date of its going into service. The Danube-Main section will result in giving a direct waterway from the Black Sea to the North Sea, which any cursory study of the map of Europe will at once suggest as an immense advantage to German industry, regardless of the clauses of the Versailles Treaty, which saw only a world interest therein.

Quake Damage to Water Supplies of Japanese Railways

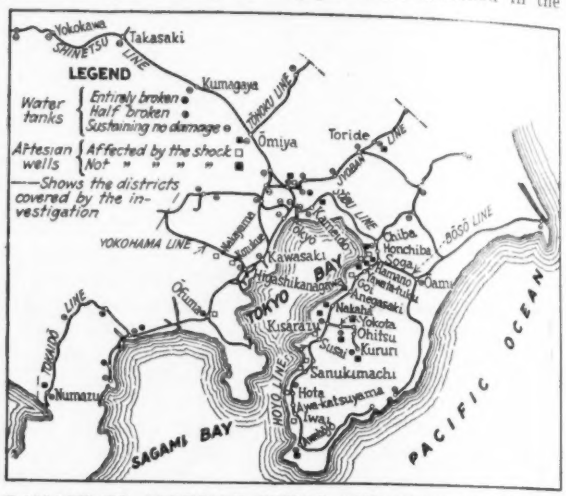
Only 26 of 96 Artesian Wells Affected by Shock and Damage to These Mostly Slight—Some Water Tanks Wrecked

By M. Nawa
Engineer-Director, Research Office, Government Railways of Japan, Tokyo

SINCE the brief report on the earthquake damage to the Japanese State Railways contributed by me to *Engineering News-Record* of Dec. 27, 1923, p. 1047, our officials have also made investigation into the effect of the earthquake shock upon artesian wells in the damaged districts. There were in all 96 wells for railway water supply in these districts, of which 26 were affected by the shock. The extent of damage to them was very small, compared with that to structures which were above ground, or which were underground but near the ground surface, such as pipes of water-system, etc.

Four wells at Ofuna Station were 1,200 ft. deep, but the iron lining extended only 20 ft. from the ground surface. In these four, earth gave way at the spots where no pipe was applied, and, choking the holes, stopped the water flow. Three have since been fully restored. On the Sô-Bu, Bô-Sô and Hôjô lines, many wells were lined with bamboo pipes and the damage to them was small.

The city of Ogaki (in Gifu Prefecture), which was visited in 1891 by the so-called "No-Bi Earthquake" ("Earthquake visiting the Provinces of Mino and Owari") with a shock of about the same degree as was experienced in Yokohama in the last earthquake, had few of its thousands of artesian wells dislocated or otherwise damaged and few of its well flows stopped; while in the water-system of Yokohama, most of the joints of its underground pipes were loosened in the earthquake. The city of Ogaki is on an alluvial deposit and is known for its artesian wells, which are 70 to 80 ft. deep lined with 2- to 3-in, bamboo pipes jointed together.



DAMAGE TO ARTESIAN WELLS AND WATER TANKS OF JAPANESE RAILWAYS BY THE 1923 EARTHQUAKE

The accompanying table summarizes the effect of the earthquake upon the wells on our different railway lines in the damaged districts and the map shows the sites of wells and indicates the extent of the damage to both the wells and the water tanks along the lines.

SUMMARY OF ARTESIAN WELLS IN THE DISTRICTS DEVASTATED BY THE JAPANESE EARTHQUAKE OF 1923

Lines	Stations	Depth of Wells From Ground Surface Ft.	Kind of Pipe	Inside Diameter of Pipes In.	Number of Wells Total	Affected By Earthquake	Remarks
Tokaido main line	Ofuna	1,200	Iron pipes were used in upper 20-ft. of well	3	4	4	In these four, earth gave at the points where no pipe was applied, choking the holes and making the water flow stop. Three have been restored, and sufficient water has been flowing out, the remaining one being still left unrepaired.
	Numazu	272—325	Iron	4	8	0	
		289	Iron	6	1	0	
		276—308	Iron	3	3	0	
Tohoku main line	Tabata	530	Iron	4	3	0	
		481	Bamboo	2	3	3	In one well, water flow increased, while decreasing in two.
		321—331	Bamboo	2	5	0	
		479	Iron	2.5—3.5—5—6	1	0	
		452	Iron	2.5—3.5—5—6	1	0	
	Omiya	300	Iron	2	8	0	
		360	Iron	2	1	0	
		720—780	Iron	2	2	0	
		365—423	Iron	12	2	0	
Jyoban line	Toride	267—279	Bamboo	2	3	0	
		234	Iron	2	1	0	
Sobu line	Kameido	120	Iron	3	1	0	
Boso line	Chiba and Honchiba	159—212	Bamboo	2.5	3	3	Well water decreased.
		305—366	Bamboo	2.5	7	2	Water flow stopped.
		486	Bamboo	3	1	1	Water flow stopped.
		660—738	Bamboo	2	6	1	In one well, bamboo pipes were damaged, but no other damage sustained.
		765	Iron	4	1	0	
Hoyo line	Soga	252—268	Bamboo	2	2	0	
	Hamano	267—285	Bamboo	2	2	1	Water flow decreased.
	Yawata-Juku	377	Bamboo	2	2	0	
	Goi	549—687	Bamboo	2	2	2	Water flow of one well decreased to ¼, while that of the other was redoubled.
	Anegasaki	411	Bamboo	2	1	0	
	Naraha	300—391	Bamboo	2	2	0	
	Kisarazu	186	Bamboo	2	1	0	
		231—388	Bamboo	2—2.5	7	0	
	Susai	81—167	Bamboo	2	2	2	Water became slightly muddy.
	Sanukimachi	372	Bamboo	2	1	1	Water flow decreased.
	Kazusa-minato	323	Bamboo	2	1	1	Bamboo pipes were broken.
	Hota	39	Bamboo	2	1	1	Water flow decreased.
	Awa-katsuyama	24	Bamboo	2	1	0	
	Iwai	51	Bamboo	2	1	1	Water flow stopped.
	Yokota	173	Bamboo	2	1	0	
	Makita	307	Bamboo	2	1	0	
	Ohitsu	587	Bamboo	2	1	1	Water flow decreased.
Yokohama line	Kozukue	240	Iron	1½	1	1	Well water decreased.
	Nakayama	260	Iron	1½	1	1	Well flow stopped.
Total					96	26	

City of Detroit Builds Heavy Traffic Pavements

New Streets Have 11½-in. Sheet-Asphalt-on-Concrete Pavements—Specifications Tightened Up Following Expert Study of Materials and Construction Practice

DETROIT is building heavier pavements under specifications which embody the conclusions of an expert engineering study in 1923 of materials and practice. Main traffic streets are now being paved with a 3½-in. asphalt top on an 8-in. concrete base. This is about the heaviest city roadway that any city as a standard practice is building. Detroit is also carrying out a new paving program which surpasses any of previous years and ranks among the big municipal undertakings of modern times. As of Sept. 1 nearly seven million dollars in paving contracts had been awarded this year. These are reasons for a brief inspection and inquiry made of Detroit paving activities, the results of which it seems certain should interest others.

Extent of Paving Operations—The recent growth in area and population of Detroit is a known story. The increased area added suddenly a great mileage of new streets and the increase in population put the added streets very quickly under intensive service. Improvement was essential over large districts almost at once. Generally speaking, therefore, Detroit's new street construction program is inclusive paving, a district at a time, of streets in the annexed zone skirting the core of old city streets improved years ago. Two characteristics follow: The paving is essentially new construction rather than reconstruction and it is a succession of group or district operations.

At the present time there are 1,700 miles of streets and 1,100 miles of alleys in the city. Of these, 970 and 240 miles, respectively, are paved. The progress in street paving activity for five years is shown by Fig. 1. The actual values for 1924 and, summarized, for 1923 are given in Table I. The absolute as well as the relative figures for 1924 are noticeable. This year, too, it has to be remembered, is a departure not only in activity, but in quality of pavement structure and technic of construction.

Structure and Construction—The new 8-in. base and 3½-in. top pavement section is shown as worked out for a 30-ft. roadway by Fig. 2. The increase is from a prevailing 3-in. asphalt and 6-in. concrete base section and is an endeavor to meet the increase in loading from more and heavier motor trucks. In the same effort the base concrete was changed from 1:3:6 to a 1:2:4 mix. These were the developments in structure in 1923, when, with a big increase of paving contemplated for 1924, it was decided to have the whole question of concrete base practice reviewed by an independent engineer. The expert's report, based on studies during the summer of 1923, was made Dec. 1, 1923, and the recommendations were virtually all embodied in the new specifications for 1924.

Reviewing some forty paving operations of the city the expert recommended more care in subgrade preparation, not to cut the original soil below grade and then refill, not to over-roll clay subgrade, to wet subgrade before laying concrete, and not to haul over subgrade without planking. In mixer operation, boom and bucket discharge was urged, with a positive device for controlling mixing water and with automatic timing devices. It was found that in practice the requirement of one-minute mixing time was being flagrantly violated. Too much mixing water was commonly used. Curing concrete base was found to have practically no attention and a wetting period of seven days was recommended. A smooth finish checked by straight-edge was recommended—this was held necessary to control ridges, waves and low and high spots.

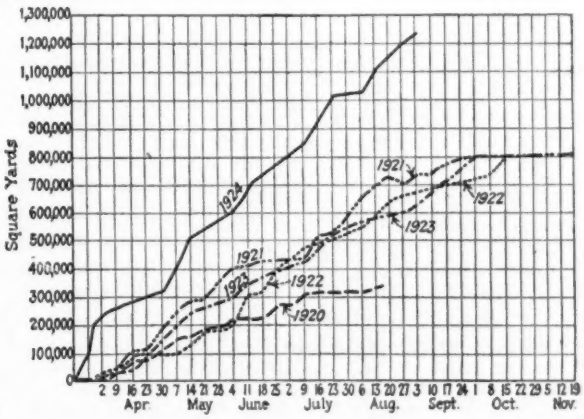


FIG. 1—GRAPH OF PAVING CONTRACTS, DETROIT, MICH., 1920-1924

The study of available materials indicated ample good sand—clean, sharp and free from clay. The following grading was recommended: Passing ¼-in. screen, 95 to 100 per cent; passing 20-mesh, 35 to 65 per cent; passing 50-mesh, 25 per cent maximum; passing 200-mesh, 5 per cent maximum; maximum 2 per cent of clay or silt. For coarse aggregate the report recommends of available material (1) gravel, (2) Monroe limestone, (3) Sibley limestone and (4) slag. Considering the size and grading of aggregate it was recommended that the grading of crushed stone and crushed slag be as follows:

	Per cent
Passing 2½-in. screen	95 to 100
Retained on 1½-in. screen, not less than	20
Passing ½-in. screen, not more than	5

The following size and grading of gravel were recommended:

	Per cent
Passing 2½-in. screen	100
Retained on 1½-in. screen, not less than	15
Passing ¼-in. screen, not more than	5

TABLE I—STREET AND ALLEY PAVING OPERATIONS IN DETROIT IN 1924

(These figures are as of Sept. 1, and do not include many petitions, in the office of the Department of Public Works, which had not been checked on that date.)

STREETS

	No.	Miles	Sq.Yd.	Cost
Under contract Jan. 1 to Sept. 1, 1924	159	58.90	1,230,260	$6,058,530
Maps made (may be let this year)	40	16.15	337,370	1,602,500
Maps made (will not be let this year)	17	4.65	97,140	461,410
No maps made (will not be let this year)	109	41.35	863,800	4,103,050
Total scheduled	325	121.05	2,528,570	12,225,490
Under contract Jan. 1 to Sept. 1, 1924	182	24.80	262,880	699,855
Map made (may be let this year)	31	4.20	44,790	111,975
Map made (will not be let this year)	11	1.50	15,900	39,750
No maps made (will not be let this year)	105	14.30	151,720	379,300
Total scheduled	329	44.80	475,290	$1,230,880

COMPARATIVE FIGURES FOR 1923

Alleys completed	185	22.64	240,425	$670,154
Streets completed	154	46.80	809,278	$4,625,223

The main constructive action of the report, however, was its change of proportions and discussion of supervision and force-account work. In respect to concrete proportions it was pointed out that two proportions of materials for concrete were used in the city during 1923, 1:3:6 and 1:2:4, cement, sand and stone, respectively. The 1:3:6 concrete was too weak for base concrete unless the thickness of it be materially increased over the then present practice. The 1:2:4 concrete, produced under good conditions, was sufficiently strong but was open to the objection that these proportions gave insufficient mortar with the materials used. This was particularly true in the case of slag, this fact being readily apparent on nearly every project on which slag was used.

On this showing it was recommended that proportions be changed to 1:2½:4½ in the case of gravel and crushed stone and to 1:2½:4 when slag was used for concrete aggregate. It was stated that a dry mix should be used with these proportions. The concrete should be mixed as dry as possible and still be workable. The consistency of the concrete as determined by the slump test should show a slump of not more than four inches. For the aggregates recommended the amount of water required for mixing to this consistency would be approximately 6 to 7 gal. per sack of cement.

The practice of the city in building bases 8 in. in thickness was held to represent good practice. Judgment, based on traffic conditions, would determine, it was stated, variations which should be made in thickness on different streets. Referring to supervision and force account work the report said:

"It is understood that the commissioner of public works has placed the supervision of paving under the direction of the city engineer. This action of the commissioner was based on sound judgment. Detroit is annually spending large sums of money on new pavement construction and large sums of money can either be saved by intelligent supervision or wasted by lack of it.

"There is considerable lack of knowledge on the part of the city inspectors on pavement construction as to their actual duties. There could be material strengthening of the inspection service if the duties of the inspectors could be carefully outlined and prescribed. A manual of instructions to inspectors on paving work to serve as a supplement to the specifications would be of great value. Inspectors should be required to keep complete records of the operations under their charge. Lack of records frequently is a source of serious difficulty in dealing with contractors in case of controversy.

"It is recommended that the present method of inspection of cement be extended to include aggregates. Astonishing lack of knowledge was displayed by city inspectors on paving projects during the investigation relative to the source of materials. The inspection of materials by a small but competent force of men, especially trained for this work, will produce a great deal of improvement in the character of materials supplied.

"Some construction work was performed by city forces. The work was performed in no better manner than that handled by contractors. Materials were used which are not permitted under the city specifications. The concrete was insufficiently mixed, a very sloppy consistency was used, and the base was not sprinkled during the curing stage.

"Construction work by city forces should be placed on exactly the same basis, and under the same supervision as that performed by contractors. All recommendations which have been incorporated in this report should apply on all work performed by city forces. Inspectors should be placed on this work with the same duties as inspectors on contract work."

TABLE II—COSTS OF VARIOUS TYPES OF ASPHALT PAVEMENT IN DETROIT IN 1923

Type	Mix	Cost	Per Sq.Yd.	Per Lin.Ft.	Per Mile
3-in. top 6-in. base...	1:3:6	$25,453	$5.80	$12.85	$87,850
3-in. top 6-in. base...	1:2:4	298,624	5.22	16.24	85,750
3½-in. top 8-in. base..	1:3:6	1,746,338	5.29	17.87	94,353
3½-in. top 8-in. base..	1:2:4	2,554,809	6.11	19.40	102,432

TABLE III—ITEMIZED UNIT COSTS OF ASPHALT PAVEMENTS IN DETROIT IN 1923

Item	Min.	Max.	Average
Excavation per cu.yd.	$0.80	$2.50	$1.44
Concrete cost per lin.ft.	1.00	1.15	1.10
3-in. nat. lake top sq.yd.	1.40	1.65	1.59
3½-in. nat. lake top sq.yd.	1.52	1.92	1.80
6-in. base 1:3:6	1.85	1.85	1.85
8-in. base 1:3:6	2.10	2.25	2.12
6-in. base 1:2:4	1.80	2.05	1.93
8-in. base 1:2:4	2.30	2.60	2.44

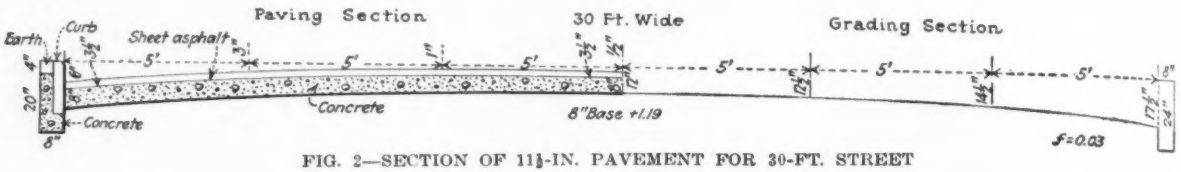


FIG. 2—SECTION OF 11½-IN. PAVEMENT FOR 30-FT. STREET

Practical Results—As stated, virtually every recommendation of the report was embodied in the specifications for 1924. Table I shows the volume of work in progress under the specifications. Largely the contracts are for complete pavements but some contracts are let for base and curb only where contractors have no asphalt plant and the top is constructed by the city asphalt plant which is also used for maintenance and reconstruction. This year as of Sept. 1, asphalt pavement largely of the heavy section has cost $4.50 a square yard including excavation, curb, base and top.

Complete costs are available only for 1923. The present specifications and rigid inspection were not in force but comparison between the new heavy and the old lighter sections is possible. Altogether 46.82 miles of asphalt pavement were constructed. Table II shows the relative volumes of work and the unit costs and Table III shows the relative costs of selected items.

All construction is under the Commission of Public Works, John W. Reid, commissioner, with George Jerome, city engineer and J. K. Mitchell, assistant city engineer in direct charge. The special report on paving practice was made by Prof. John H. Bateman, Civil Engineering Department, University of Michigan, Ann Arbor, Mich.

Time Charge Replaces Bonus and Penalty Clauses

Operated Successfully in Over a Hundred Contracts, Approved by City Law Department and Liked by Contractors

By Henry H. Quimby
Consulting Engineer, Philadelphia, Pa.

ONE OF THE most unsatisfactory things connected with the adminstration of contracts, especially in public works, is controlling the time element—influencing the contractor to hustle. The common liquidated damages clause, designed and inserted for that purpose, long ago proved ineffective. All feel that the principle has been established that liquidated damages, at least as predetermined and specified, are really a punitive measure, and that a penalty cannot legally be imposed unless the contract provides as distinctly for the earning of a corresponding premium. However, a method is here suggested whereby a contract can be made to provide an additional incentive to the contractor to speed up his work, the provision operating automatically so as to become either a bonus or a penalty, depending upon whether the actual completion anticipates or exceeds the contractor's own estimate of time to be consumed in the work.

This method is to provide in the contract for a daily charge against the contractor from the beginning to the end of the work, of course including in the information for bidders the fact and the rate of the charge. Each bidder then in making up his bid includes, in his estimate of the cost of the work, the aggregate of the charge for the whole time that he estimates he will require to complete it—not necessarily the time prescribed by the specifications. Then if he completes in less time than he estimated he wins a bonus, for less is deducted from his contract price than his bidding estimate of cost covered; and if he consumes more time than he estimated, the excess of the charge deducted from him in settlement will be a reduction of his compensation and will have the effect of a so-called penalty.

Applicable to Public Work—The method is applicable to both public and private work, and may be the only way by which a premium can actually be paid under public works contracts. It has been in use for ten years on perhaps a hundred contracts, and has not yet got into court in litigation. Its operation is simple and its enforcement is easy, difficulties appearing only when changes in plans are made, or other complications arise which in any case would require negotiations for adjustment of contractor's compensation, and entail the exercise of judgment, and involve agreement between the parties.

A common practice formerly was to permit bidders on public work to state in their bids the time they would require to complete the work, the time promised in the accepted proposal to become the contract time. This, not strangely, brought about the award of contracts to others than the lowest bidders, until the courts decided that bids under such conditions are not on a uniform or equal basis, and that the time allowed for the work must be prescribed in the specifications along with the other requirements. When the practice of applying a time charge was inaugurated a definite date was set when the work was desired to be completed, but bidders were permitted to propose a longer time, any excess time so bid over that called for in the specifications to be added to the aggregate proposal price at the rate specified for the time charge merely for comparison of bids, thus to that extent handicapping without ruling out any bidder who desired more time, but after the first few contracts under such specifications were entered into it was seen that the bidder must and will provide in his estimate of cost—and therefore in his contract price—for whatever excess time he might estimate he would require.

How It Operates—The operation of the scheme in a typical construction contract is as follows, the attention of prospective bidders being called to it at three different points in the specifications in order to prevent their overlooking it in making up their bids. The Information for Bidders states:

> Time is an essential element in the contract, and the work shall be completed by June 30, 1925. As the prosecution of the work will unavoidably incommode the public, obstruct traffic, and interfere with business, it is important that the work be pressed vigorously to completion. Also the cost to the commission of the administration of the contract, including inspection, surveying, and supervision, will be increased or decreased as the time occupied in the work is lengthened or shortened. Therefore a time charge will be made against the contractor, and the amount of it be deducted from the contract price when payment is made. This charge, which will be commenced Oct. 1, 1924, and continue until the work is done and all other plant obstructions removed from the streets, and which should be included by each bidder in his cost estimate of the work for all the time he would consume in the work, will be at the rate of fifty dollars ($50) for each calendar day, except Sundays, elapsing from and including Oct. 1, 1924, to and including the date of completion and cleaning up. The time charge will be suspended during the period of any delay that may be caused by the commission either through delay in approval of the contract so that work cannot be commenced Oct. 1, 1924, or through changes in the plans, or through ordering suspension of the work for any reason, and in such case the contract time will be extended correspondingly.

Also under the heading of Contract Price Includes, after enumerating the different features of the work is the statement, "it shall also include the time charge at the rate of fifty dollars per day."

Also under the heading Payments it is stated: "Current and final payments will be reduced by the amount of the time charge for the period covered."

The contract time from Oct. 1, 1924, to June 30, 1925, is 233 calendar days excluding Sundays, and if a bidder estimates that he will require just that time he will add to his estimate of the cost of the work $11,650, increasing his bid by that amount. If as the contractor he just meets that date in completing the work, no changes in plans having been made, he and the commission will break even on the time charge, the deduction from his contract price at settlement being exactly the amount he put in his bid for the commission to deduct. If he completes the job in, say, 200 days there will be deducted from his price only $10,000 whereby he wins a premium of $1,650. If on the other hand he consumes 266 days there will be deducted from the payment $13,300 for the time charge which therefore becomes a penalty to the extent of $1,650.

Experience With Plan—The scheme has proved workable in practice. In perhaps a hundred, only two or three cases developed entire oversight of the provision and consequent failure to cover it in the estimate of cost

for bidding. The more common occurrence is that bidders figure on just the prescribed contract time. Bidders have no occasion to disclose their estimate of time and amount included for time charge unless the plans are so materially altered after work has commenced that an entire readjustment of the price is necessary. In such a case it will probably be necessary to commute the per diem rate into a lump sum for the job, and the contractor may or may not exhibit his original make-up sheet to establish his claim of the figure assumed for his bid, and a compromise may be in order. Such a condition appeared some years ago in the prosecution of a lump sum contract partially performed when a large amount of preliminary work was added and substituted for structure, whereby it would have been impossible to determine an equitable application of the time charge. The contract was $2,000,000 and the time charge was $100 per day. The contract time was 2½ years, but the contractor claimed that he had assumed that he would complete it in two years and therefore had put into his estimate of cost only $60,000 instead of $75,000 as the contract time would have called for. He agreed to a compromise by splitting the difference and in the readjustment the time charge was commuted to $67,500, which was deducted from the value of the original contract price.

The plan has been applied to unit price contracts as well as to lump sum contracts. Also it has been applied in differing rates to separate portions of a contract according to their relative importance and urgency.

There should be no more difficulty in adjusting a contractor's claim for delay due to changes in plans than there is in the agreement upon the amount of extra cost of work involved in such changes. Generally such extra cost cannot be definitely determined because of the attaching imponderables, and in the great majority of cases an agreement upon the amount is reached in the exercise of judgment and a co-operative spirit of compromise.

It may be said that in general if a contract is of such character and importance as to justify imposing a penalty, the time value attaching will justify in public as well as in private work the payment of a bonus which in no case under the above arrangement can be excessive, and in any event is minimized by the competitive conditions.

The time charge is almost universally approved by competent contractors as being equitable and even desirable.

Census of French Building Construction

The latest figures published by the French minister of finances indicate an increase of a hundred and ten million francs collected in house taxes over those of the year 1922. Of this sum the Paris district produced the largest revenue, 215,852,889 francs as against the Nord department which followed with 31,053,109 francs. The number of buildings existing throughout France by various years are as follows, omitting the war years, when no statistics were made available:

	House	Factories	Total
1901	9,120,673	128,531	9,249,200
1911	9,415,968	137,244	9,553,212
1913	9,473,569	141,527	9,615,096
1920	9,256,183	146,843	9,403,026
1921	9,260,456	149,645	9,410,101

Economic Penstock Design Proposed

ENGINEERS interested in the intricate problem of penstock design, from both the mechanical and civil engineering societies, took part in the discussion of a paper entitled "A Method for the Economic Design of Penstocks," by H. L. Doolittle, assistant construction engineer, Southern California Edison Co., presented at the annual meeting of the American Society of Mechanical Engineers on Dec. 4. The paper, together with a discussion of it by Prof. Robert L. Daugherty of the California Institute of Technology, was published in the mid-November issue of *Mechanical Engineering*, the monthly journal of the society.

The method, according to Mr. Doolittle, is not an exact solution of an intricate problem, but is believed to be correct enough for all practical purposes and very simple in its application. In this method of design it is taken as a working premise that "the most economical penstock will be that in which the sum of the annual value of the power lost in friction and the annual interest, depreciation, taxes, etc., is a minimum."

The fundamental principle of the method is as follows: If a curve be plotted with length of pipe as abscissas and *total* annual cost *per foot* as ordinates, the area under the curve will be proportional to the total annual cost of the entire pipe line. The ordinate at any point represents the cost of the pipe per foot at that particular position in the line. If, now, several curves be drawn on the same chart for different diameters of pipe, the most economical pipe will be the one made up of the various diameters and giving the minimum area between the pipe curves and the x-axis.

The author then goes on to show by an illustrative problem the method of applying his theory. He points out that the following items must be given consideration: (1) Daily variation of flow through the pipe; (2) estimated load factor of the plant over a term of years; (3) profile of the line; (4) number of pipes; (5) kind of pipe to be used; (6) diameter and thickness of pipe; (7) value of power loss in friction; (8) cost of pipe installed; (9) cost of pier and anchors; (10) annual cost of the pipe in place; (11) increased thickness to provide for water hammer or corrosion; (12) maximum permissible velocity. Each of these items is discussed in the presentation of the illustrated problem, the details of which will not be reproduced herewith.

The gist of the discussion was that Mr. Doolittle had presented a valuable, practical method of designing pressure pipe lines; one which, with certain amplifications, could be used quite generally. A number of the speakers were of the opinion that the use of the word "penstock" in the title was unfortunate, because, in the East at least, the term "penstock" is applied to the relatively short length of pipe between the surge tank and the power house, and that the conditions which Mr. Doolittle has enumerated do not apply as generally to the penstock, as so defined, as they do to the longer length of pipe line between the surge tank and the intake. Amplification, according to some of the speakers, should include some simple way of applying the effect of water hammer to the design and also some logical way of evaluating the power lost or gained by changes in the pipe line sizes. It was also considered that any design should consider and provide against the possibility of collapse of the pipe line due to a sudden increase in load on the wheels.

Port Authority Asks Engineers to Bid on Bridge Design

Invites Bridge Engineers to Submit Proposals for Preparing Designs and Estimates for Staten Island Bridges

AN UNUSUAL course was taken recently by the Port of New York Authority in preparing to select an engineer to make designs and estimates for two large bridges which the Authority has been instructed by the legislatures of New York and New Jersey to build. These bridges are to connect Staten Island with New Jersey, one of them at the crossing from Elizabeth to Howland Hook, the other at the crossing from Perth Amboy to Tottenville. Engineers were asked by formal letter of invitation to submit bids for doing the required engineering work. The letter is reproduced below.

The two bridges in question are likely to cost upward of $5,000,000 each, but the legislatures appropriated only $100,000 each for the required preliminary investigations and designs (including surveys, borings and other work carried out by the staff of the Port Authority). According to the law under which the Port Authority operates, the construction cost is to be raised by bond issues backed by the earning power of the bridges but not supported by public credit. Under the circumstances it was necessary that the bridges be planned by an engineer of recognized standing, to assure the confidence of prospective bond buyers, although only a small sum was available as compensation for this engineer. It was desired, also, to have the designs and estimates completed within less than two months.

The letter of invitation was addressed to four or five prominent bridge engineers experienced in the planning of large bridges. It asked for "proposals"; as no statement of qualifications was requested this term evidently refers to fees and time, which fact is also expressed in the passage, "Separate figures should be quoted and times given for preliminary and final designs." The letter did not state that similar letters were sent to other engineers. Its text follows:

11 Broadway, New York, Nov. 7, 1924.

Dear Sir:

The Port Authority has been instructed by the states of New York and New Jersey to build two bridges across the Arthur Kill, one between Perth Amboy and Tottenville, Staten Island, the other between Elizabeth and Howland Hook, Staten Island. Some preliminary estimates have been made on these bridges and amount to about five million ($5,000,000) dollars for each location. The bridges if built by the Port Authority will have to be self-sustaining from the revenue derived and should therefore not cost, in our judgment, much over six million ($6,000,000) dollars apiece, exclusive of real estate.

The Port of New York Authority has completed topographical surveys and triangulations and let contracts for borings to determine foundations. These borings, however, will not be complete until the middle of December next. The overhead clearances above the Arthur Kill and the clear waterways required for traffic on the Arthur Kill have not as yet been definitely determined but will be within the next few weeks.

I am attaching a profile and map of each of the locations with clearances and spans based on conditions that we believe we will be able to obtain from the War Department as to span and clearances. We desire to secure the services of a bridge engineer and wish you to make a proposal for carrying on the work.

If your proposal is accepted, it is understood that should the bridges be built you will stay on to protect your design and estimate.

We wish the proposal on two bases: First, on a design and estimate which will be accurate within ten or fifteen per cent; second, on a complete and accurate estimate and design based on the borings and other information which will be furnished you by the engineering staff of the Port Authority; neither of these estimates to include cost of real estate or contingent damages, as these will be taken care of by the staff of the Port Authority.

Time is an essential element in the preparation of preliminary design and estimate. It also has a bearing in the preparation of the final estimate. Separate figures should be quoted and times given for the preparation of the preliminary estimate and design and for the preparation of the final estimate and design.

In preparing the report you will have to work in co-operation with the engineering staff of the Port Authority. The Port Authority will pay for the expense of the publication.

For the bridge between Elizabeth and Howland Hook, there will be two twenty-foot driveways for highway traffic with a separating curb between driveways, and one eight-foot sidewalk on the northerly side of the bridge. For the bridge between Perth Amboy and Tottenville there will be two twenty-foot driveways for highway traffic with a separating curb between them, and an eight-foot sidewalk on the northerly side of the bridge. The trusses and other members, however, should be made strong enough to support two rapid transit lines, one on each side of the central vehicular driveways and on the same horizontal plane. The floor system for these rapid transit lines will not be constructed at the present time and the sidewalk will replace one of them, the sidewalk eventually to be placed over one of the rapid transit lines. The cars of the transit line are to be similar to the cars operated in the city's subways.

For the preliminary estimate and design of the northerly bridge, it may be assumed that rock will be found at 35 feet below mean high water. This is a comparatively soft shale rock. For the southerly bridge it is not expected that rock will be found at any reasonable depth. The best information obtainable shows that the sub-stratum here is known as the "Raritan formation" composed of dark lignited sand and clay overlaid with variable sand and clays of lighter color.

We desire you to state in your proposal the governing factors in design, loadings, impact, allowances, unit stresses, etc., to be employed. Your proposal should embrace for the preliminary design and estimate the furnishing of small scale plans of each structure, full profiles on a comparatively small scale, typical cross-sections at change points showing the driveway arrangements, and perspective drawings.

Your final estimate to be based on accurate and definite designs, preparation of stress sheets, stress calculations, for principal parts of each structure, preparation of general plans, of piers, abutments and typical pedestals, preparation of ample large scale drawings showing in elevation and cross-section all important parts of the structures, preparation of accurate estimates of quantities based upon the calculations, stress sheets and masonry plan. Preparation of final design, estimate and report should follow immediately completion of preliminary report.

Should the essential features of either or both bridges differ materially from the designs and estimates furnished in the preliminary report, it of course will become necessary to furnish us with adequate plans, profiles and cross-sections where these differences occur, in addition to a revised perspective if necessary.

It is desired to have your proposals by Tuesday afternoon, November 11.

Yours very truly, W. W. DRINKER,
Chief Engineer.

On Dec. 7 the Port Authority announced that it had selected Prof. William H. Burr as consulting engineer and J. A. L. Waddell as designing engineer. We understand that Professor Burr's appointment was not involved in the invitation for proposals but antedated them. Dr. Waddell was one of the engineers invited to submit a proposal. No statement has been made by the Port Authority as to its action on the proposals, other than the published announcement of the engineers selected.

Early Results from Memphis Water Purification Plant

Air-Lift, Aerators, Mechanical Filters and Chlorinators Remove Iron, Carbon Dioxide, Hydrogen Sulphide and Bacteria From New Well Supply Meeting Initial Demand of 15 M.G.D.

By Wellington Donaldson
With Fuller & McClintock, Engineers, New York City

ON JUNE 15 the new works for the underground water supply of Memphis, Tenn., construction of which was started late in 1922, were put into regular operation, although the works as a whole had not yet been accepted by the city on account of certain delays in completing pumping machinery contracts. The following remarks deal principally with the quality of the supply and the purification problems, as the details of both the old system and the new works have been adequately described in several published articles indicated in the appended list. However, a brief description is not out of place here to make intelligible some of the problems of the supply and purposes of the new structures.

Memphis with a 1920 census population of 162,351 now supplies an estimated population of about 180,000, the average demand on the water-works being about 15 m.g.d., equivalent to 83 gal. per capita. The relatively low per capita consumption compared with other American cities of the same size is due to the ease with which underground water may be obtained, in any section of the city, resulting in a general practice on the part of large industries, railroads, utility companies, hotels, laundries, etc., of maintaining private water supplies from wells on the premises. The amount of water so abstracted from the ground is in excess of the amount handled daily by the public water supply.

Old Supply Works—The original water-works of Memphis were constructed by a private company in 1872, utilizing Wolf River, a small tributary of the Mississippi, as a source. The river supply was not satisfactory on account of high turbidity and absence of treatment, but was continued until 1889 when it was supplanted by an underground supply developed by the reorganized company known as the Memphis Artesian Water Co. The original wells were connected by pipe laid on the ground. It is reported that the natural water level in the first wells drilled varied from a few feet below ground to from 6 to 7 ft. above.

In 1890 a novel system for collecting ground water was inaugurated by sinking a vertical shaft 10 ft. in diameter and 80 ft. deep. From the shaft a brick-lined tunnel led off in the clay stratum at a depth of 75 to 80 ft. below the surface. Wells were drilled adjacent to the tunnel and tapped by a special connection some 70 ft. below the surface, and the water was led by gravity through wooden-lined drifts connecting with the main tunnel. A pumping station was built over the main shaft, taking suction therefrom, and delivering water to the city. This system, consisting of about one mile of main tunnel, five miles of drift tunnels and numerous wells, constituting what is known as the Auction Ave. supply, was in continuous use until supplanted by the new works in 1924. The works were purchased from the private company by the city in 1903 and subsequent developments and improvements have been carried out by the municipality.

In 1906 limitations of the Auction Ave. supply having been reached due to fixed elevation of tunnel and pumps, a temporary air-lift installation was made in South Memphis, drawing from a small group of drilled wells. This plant was subsequently abandoned. In 1908 a second air-lift installation was made in the eastern section of the city. This development, known as the Central Ave. station, was also operated continuously until supplanted by the new works in 1924.

A fourth phase in utilization of the ground water was marked by the installation in 1910 of the first "segregated" well, followed in 1911 to 1913 by installation of 14 additional wells of the same type scattered in the eastern and southern portions of the city. These wells were equipped with a double pumping device mounted on a vertical shaft, the lower member, submerged in the well casing, being a modification of the Archimedes screw, while the upper member was a centrifugal pump mounted on the well casing. These pumps, design of which is credited to W. J. Wills, then superintendent, were driven by direct-connected electric motor and delivered direct into the mains against about 50 to 60 lb. pressure. The motor and centrifugal pump of each of the segregated wells, together with a valve and flow indicator, are housed in a covered concrete vault, the top of which is level with the street, access being provided by means of manhole and ladder. In addition to the 15 segregated wells, just described, another well has in recent years been equipped with a pump consisting of two motor-driven centrifugal units mounted on the same vertical shaft, also pumping direct into the mains. With the completion of the new works in 1924 all segregated wells have been discontinued, though still available as standbys.

As the matter stood prior to starting up the new works in 1924 there had been put down in 35 years of development a total of 194 wells varying in size from 6 to 13 in., but mostly 10 in. The supply was derived from the several sources in approximately the following amounts:

	No. Wells	Average Yield M.G.D.
Auction Ave. (underground tunnels)	21	7.0
Central Ave. (air-lift pumping)	5	4.0
Segregated wells (direct into mains)	14	4.0
		15.0

High demands were met by starting up additional segregated wells.

New Supply Works—The new works put in commission in 1924 supplant all collecting and pumping arrangements, previously described. They include also considerable reinforcement of the existing distribution system and special purification facilities for removing objectionable impurities present in the ground water. Improvements have been dictated by the depreciated condition of old machinery, high maintenance and operating cost, and by the need for a better quality of water, both as to freedom from iron rust and the hazard of pollution to the underground tunnel system.

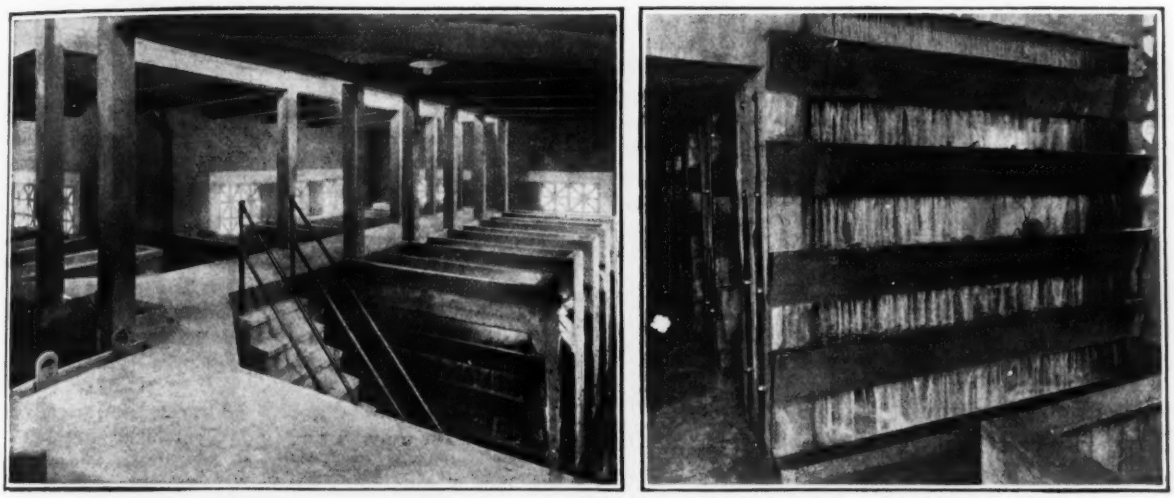
Wells—The new supply is drawn from 21 new 12-in. wells and one 10-in. well previously drilled but not connected with the old supply. Four of the wells are on the station grounds and 18 are stretched eastward along the North Parkway boulevard system a distance of about 9,500 ft. from the station. Depths of the new wells range from 349 to 531 ft. with an average of about 490 ft., all inclusive of 55-ft. effective strainer depth. Each well has a superstructure of stone-trimmed brick, housing the collecting chamber, air meter, water meter, automatic air control device, pressure and lift gages. Air is supplied from compressors at the Parkway pumping station. The average lift for a combined output of 15 m.g.d. is about 90 ft. Yield of individual wells is adjusted to give uniform lift and varies from 400 to 900 g.p.m. in ordinary operation. Some of the wells are capable of yielding 1,200 gal. per minute.

From the individual wells the water, after being disengaged from air and the greater part of objectionable gases, flows into a common collecting main and thence by gravity to an equalizing basin of 1-m.g. capacity at the pumping station, from which it is lifted by water-turbine-driven centrifugal pumps to the aerator, flowing thence by gravity to the rapid sand filters, thence to suction of the city pumps or to storage reservoir holding 9 m.g., according to demand.

Aerators—Aeration is accomplished in a building separate from the pumping station and the filter plant. Strictly speaking, the function of this unit of the plant is not aeration but "decarbonation," for the air-lift at the wells practically saturates the water with oxygen besides removing about 75 per cent of free carbonic acid (carbon dioxide) and practically all hydrogen sulphide. The purpose of the aerator, therefore, is to remove as much as possible of these objectionable gases not taken out by the air-lift.

The aerator structure has a roof, but is well ventilated by roof monitors and by open terra cotta grillwork windows on all sides. The building plan is in the form of a cross to permit favorable arrangement of aerating devices. The water pumped from the equalizing basin enters through the riser well shown in the left foreground of the accompanying interior view of the aerator house and then flows through the four covered flumes supplying the quadrants. Any quadrant may be shut off by stop planks, as shown. It has been found that each quadrant will take a flow of about 13 m.g.d. Each quadrant consists of ten aerating units, five on each side of the supply flume. The water is distributed to each aerator unit by concrete troughs with perforated copper bottoms. Each unit consists of four superimposed trays, 10 in. deep, spaced 9 in. apart. The bottom of each tray is copper mesh wire to support a layer of 2- to 4-in. crushed coke. The single units are 2x7 ft. in plan, or 14 sq.ft. net area; thus each quadrant has an effective coke area of 140 sq.ft., making a total of 560 sq.ft. in the whole building. Head utilized for aeration is approximately 9 ft., counting from flow-line in distributing trough to flow-line in filters. The aerated water flows through a small baffled chamber underneath the floor and thence to the filters. The purpose of this chamber is to provide adequate mixing in case lime should be applied to further reduce carbonic acid.

Filters—The filters are of the conventional rapid sand type and would be equally suitable for handling surface water. The filter plant comprises eight reinforced concrete units, each with 825 sq.ft. filtering surface. The units have perforated pipe underdrains, galvanized. The filter beds are composed of 18 in. of graded gravel below and 30 in. of sand above, the



AERATOR HOUSE INTERIOR AND NEAR VIEW OF ONE AERATOR UNIT AT MEMPHIS WATER PURIFICATION PLANT

In left foreground of the larger view, a stop plank admitting water from riser well to one of the flumes feeding one of the four groups of aerators may be seen. More detailed view at right shows a stack of four aerator trays, fed with water from above.

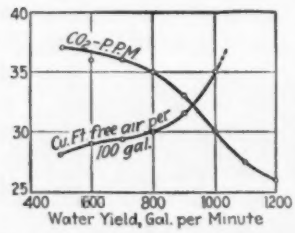
TABLE I—ANALYSIS OF WATER FROM WELL NO. 194

(By W. F. Monfort, 1922)		Parts Per Million
Silica	(SiO_2)	10.7
Alumina and ferric oxide	(Al_2O_3, Fe_2O_3)	1.9
Iron	(Fe)	1.1
Manganese	(Mn)	0.065
Calcium	(Ca)	8.6
Magnesium	(Mg)	4.0
Sodium and potassium	(Na)	10.2
Bicarbonate	(HCO_3)	78.1
Carbonate	(CO_3)	0.0
Sulphate	(SO_4)	0.0
Chloride	(Cl	4.0
Nitrate	(NO_3)	0.01
Residue on evaporation		78.0
Computations from above		
Hardness (excluding iron)	($CaCO_3$)	38.0
Alkalinity—total	($CaCO_3$)	64.0
Alkalinity due to alkali carbonate	($CaCO_3$)	26.0
Incrustant	($CaCO_3$)	0.0

latter having a specified effective size of 0.4 to 0.5 mm. Each unit is equipped with a controller, adjustable from the operating floor. Control table fixtures include hydraulic valve controls, indicating gages for loss-of-head and rate-of-flow, and single recorder for both.

Included in the filter house equipment are a pedestal type chlorinator for emergency use and two machines for feeding hydrated lime, in case further treatment of water should be desired. Laboratories of the Water Department are in the same building.

Character of the Underground Water—The chemical qualities of the untreated water are well represented by the mineral analysis shown in Table I, sampled from a single well of the new field. The absence of permanent hardness and presence of sodium carbonate make the water excellent for steam raising purposes and experience has shown that boilers properly cared for are troubled little with scale.



RELATION OF WATER YIELD TO AIR CONSUMPTION AND CO_2 CONTENT, WELL 204

Besides the iron present in the well water there are two other objectionable constituents not shown in the table—carbon dioxide and hydrogen sulphide dissolved as gases. The former has been found to range from 81 to 128 p.p.m., as sampled from various wells equipped with deep-well pumps. This relatively high amount of carbon dioxide has been responsible in the past years for much of the rusty water experienced in the city, as it has caused active corrosion in the distribution system and resulted in a higher iron content at the faucet than found in the sources of supply. Thus the iron content of the Auction Ave. supply ran consistently about 1.8 p.p.m., yet samples from consumers' faucets not uncommonly contained 5 p.p.m. and over. This tendency towards corrosion has resulted in the general use of lead service pipe and plumbing throughout the city, and in some cases brass plumbing.

The hydrogen sulphide present in the underground water has not been estimated quantitatively, but is quite noticeable to the taste in drinking unaerated water and is strongly in evidence by its odor where the water is raised by air-lift, and by its chemical effect on painted surfaces and metal fixtures.

Table II gives recent results of sampling from each of the new wells constituting the present supply. It will be observed that of the 22 wells in the same water-bearing stratum there are considerable variations in physical and chemical characteristics. A few of the new wells have such a low iron content as not to need purification, but others have objectionable amount, which means for this water 0.3 p.p.m. and above.

Removal of Dissolved Gases—The actual CO_2 content of the new wells before air-lift pumping is not known,

TABLE II—VARIATION IN QUALITY OF THE 22 NEW WELLS AS PUMPED BY AIR-LIFT

	Parts Per Million			
	Ave.	Max.	Min.	
Total solids	81.3	88.0	73.0	
Alkalinity	60.6	63.5	57.0	
Soap hardness	42.0	44.0	40.0	(4 wells)
Iron	0.57	1.00	0.10	
Chloride	2.80	3.1	2.0	
Free CO_2	33.6	40.0	30.0	
Temp. deg. F.	62.7	66.4	61.7	
H-ion concentration (pH)	6.4	6.4	6.4	(8 wells)

TABLE III—SUMMARY OF PRELIMINARY OPERATING RESULTS

	July	August	September
Water handled, M.G.D.	16.23	16.38	14.61
Filters, final loss-of-head, ft.	8.2	8.5	8.6
Number units washed per day	3.4	2.9	2.3
Filters, Average hours run between washings	55.3	67.6	77.6
Per cent wash water	0.86	0.75	0.74
Free CO_2, aerator inlet	31.6	33.0	33.2
Applied to filters	....	9.0	8.2
Filtered	7.7	7.6	7.7
Total iron (Fe), aerator inlet	0.53	0.64	0.87
Applied to filters	....	0.45	0.63
Filtered	.01	0.01	0.03

but from determinations on other wells equipped with deep-well pumps an average figure of 120 p.p.m. is assumed for the water as it lies in the underground stratum. On this basis the air-lift removes about 73 per cent, leaving a residual of some 33 p.p.m. to be removed by later treatment. It has been found that the removal depends upon the air-to-water ratio of the air-lift; so that the CO_2 figure is a fair index to the pumping efficiency of a particular well. This is illustrated graphically by Fig. 2. Hydrogen sulphide is practically eliminated by the air-lift.

Iron Removal—The removal of dissolved iron begins with the introduction of air into the wells, which oxidizes the metal. After oxidation, deposition occurs on any surface in contact with the water. The red stain of ferric oxide is observable on the concrete of the collecting basins around the well heads and is markedly in evidence on coke surfaces in the aerator trays, and on the supporting slabs of the aerator. Thus the entire system of piping and structures from wells to filters constitutes an iron-removal device, before the water reaches the filters, where the removal is completed.

Table III gives the principal operating results of the plant for July, August and September, 1924.

The writer is indebted to F. A. Mantel, chemist of the Water Department, for assistance on the field tests and for use of operating data summarized above.

References—The following are the principal references to the Memphis Water Supply, both old and new:

1. Lundie: (report on system) *Eng. News* (1902) 48: 248.
2. Hider, Omberg & Bell: (report on system) *Eng. News* (1902) 48: 245.
3. Anon.: (segregated wells) *Eng. News* (1916) 75: 1028. *Eng.-Contr.* (1916) 45: 349.
4. Glenn: (Geology and wells) W. S. Paper No. 164, U. S. Geol. Survey (1906).
5. Chester & Davis: (general) *Jour.* A.W.W.A. (1921) 8: 378.
6. Fuller & McClintock: (report on works) *Eng. N.-Rec.* (1922) 89: 566.
7. McClintock: (new works) *Jour.* A.W.W.A. (1923) 10: 1056.
8. Donaldson: (aeration experiments) *Eng. N.-Rec.* (1923) 90: 874.
9. Cunningham: (new works) *Pub. Wks.* (1923) 54: 371. (1924) 55: 13. *Fire & Water,* March 26, 1924: p. 591.

Centrifugal Pipe in England

The Vianini centrifugal concrete pipe, which was used so extensively on the great Apulian Aqueduct (*Engineering News-Record,* March 1, 1923, p. 389) in Italy, has been introduced and is now being manufactured in Britain. These pipes are made by the centrifugal process in units 12 ft. long, in both socket and spigot types. The mixture used is portland cement and crushed granite, the pipes being spun in zinc molds with watertight joints, the reinforcement being steel bar. In assembly the joints are packed with asphalt, lead wool or concrete and oakum. The Apulian Aqueduct, where attention was first attracted to the Vianini pipe, is 125 miles long, and 69 miles of these pipes, from 6 in. to 32 in. in diameter, were used, the water pressure being 36.75 lb. per sq.in.

Three New Allegheny River Bridges To Be of Unusual Type

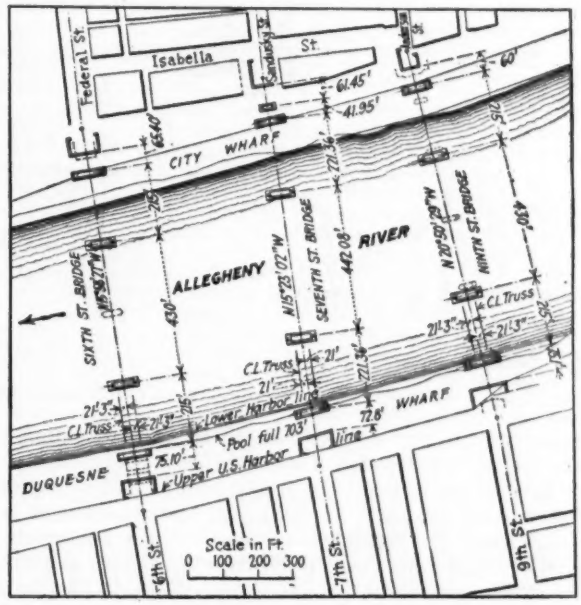
Self-Anchored Chain Suspension Type Selected for Downtown Bridges Which Require Rebuilding

DESIGNS have been prepared by Allegheny County (Pittsburgh) for the superstructure of three new bridges across the Allegheny River, to replace existing bridges at Sixth St., Seventh St. and Ninth St. which interfere with navigation. Foundation work on the piers required for the new crossings is already in progress, contracts having been let a month ago. Bids on the superstructures have been asked for Dec. 22. The superstructure plans show a remarkable type of bridge, namely, a chain suspension bridge without anchorage, the chain pull being resisted by compression in the stiffening girder. A bridge of this type built across the Rhine River at Cologne, Germany, about ten years ago, is probably the only other example of the type in existence.

The Allegheny project is unique also in that three bridges of like design are being erected as a group, effecting, among other things, economy in design, fabrication and construction work.

Drawings of the Seventh St. bridge are shown herewith. It differs from the Sixth and Ninth St. bridges, which are alike, only by a few feet in span length and resulting minor divergences.

A hearing was held in 1916 by a board of engineers of the War Department, and this board subsequently recommended to the Secretary of War that six bridges over the Allegheny, within the city of Pittsburgh, be altered to give greater underclearance for navigation and a more satisfactory channel location. The struc-



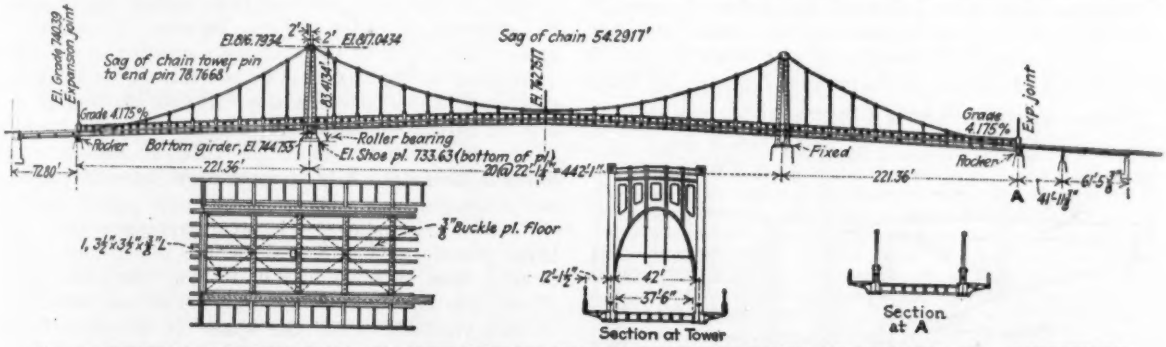


FIG. 1—GENERAL CONSTRUCTION OF NEW BRIDGE OVER ALLEGHENY RIVER AT SEVENTH ST., PITTSBURGH

The bridges at Sixth and Ninth Sts. will be of the same type and nearly of the same span length. The three bridges will be of identical appearance. The main cables are eyebar chains. The bridge is stiffened by heavy box-girder members at roadway level. These girders also act as struts to resist the cable pull, eliminating the anchorage required by the ordinary suspension bridge. One of the towers is fixed to its pier; the other tower and the two ends have expansion bearings. The upper drawing shows the location of the three bridges.

The designs were worked out by the engineering division of the Department of Public Works, of Allegheny County, under the general direction of Norman F. Brown, director, and C. M. Reppert, assistant director. They were prepared by V. R. Covell, county engineer, and T. J. Wilkerson, consulting engineer, and A. D. Nutter, engineer of bridge design, of the bureau of bridges. However, the city art commission played a part in determining the type of structure, as indicated below. The following is in large part quoted from data supplied by Mr. Wilkerson.

Reasons for Construction—Eight or nine years ago navigation interests petitioned the War Department for improvement of navigation conditions in the Allegheny River at Pittsburgh. Most of the bridges over the Allegheny within the city had previously been owned by private corporations, but they had been bought by the county a short time before this petition. tures in question were those at Sixth, Seventh, Ninth, 16th, 30th, and 43rd Sts. Reconstruction according to this recommendation was subsequently ordered by the Secretary of War; the order was suspended during the war, when the required steel could not be obtained, but was later renewed.

Four years ago replacement of the 16th St. bridge was begun, under designs prepared by Warren & Wetmore and H. G. Balcom. This bridge was completed a year ago. The 43rd St. bridge has been replaced by one at 40th St., just completed; this structure was designed by Benno Janssen and Charles S. Davis. The three important downtown bridges, however, presented so difficult a problem, on account of their heavy traffic, that little progress toward their reconstruction was made until the present year.

Selection of Design—Two years ago a design for the Seventh St. bridge was prepared by the county engi-

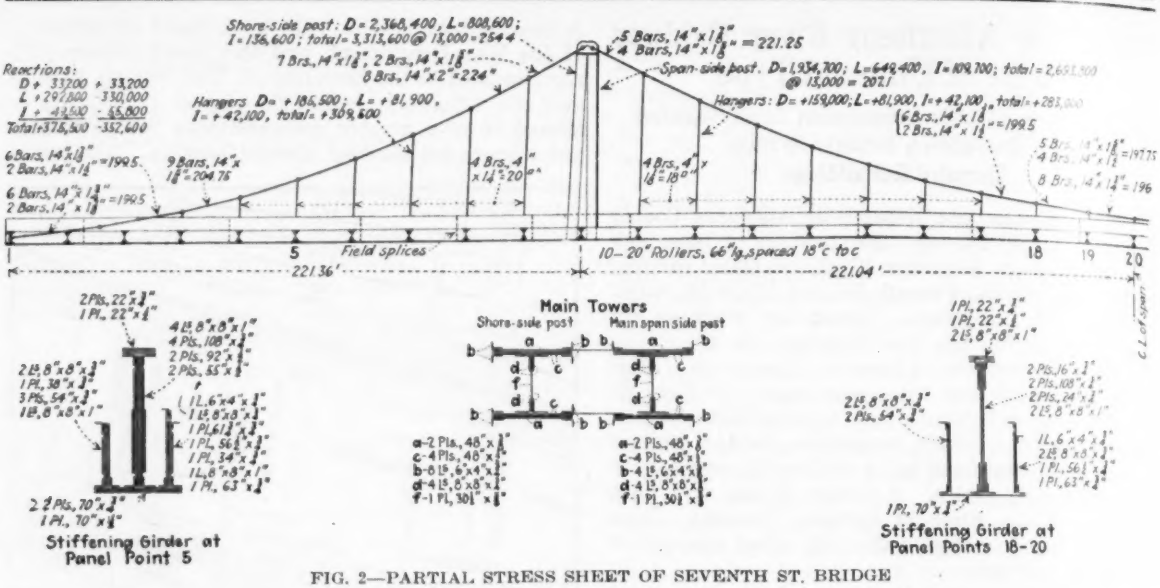

Shore-side post: D = 2,368,400, L = 808,600; I = 136,600; total = 3,313,600 @ 13,000 = 254.9
Span-side post. D = 1,934,700; L = 648,400, I = 109,700; total = 2,693,300 @ 13,000 = 207.1
Hangers D = +186,500; L = +81,900, I = +42,100, total = +309,600
Hangers: D = +159,000; L = +81,900, I = +42,100, total = +283,000
Reactions:
D + 33,200 + 33,200
L + 291,800 - 330,000
I + 42,500 - 55,800
Total +376,500 -352,600
Field splices
10-20" Rollers, 66" lg, spaced 18"c to c
221.36'
221.04'
Main Towers
Shore-side post
Main span side post
Stiffening Girder at Panel Point 5
Stiffening Girder at Panel Points 18-20

FIG. 2—PARTIAL STRESS SHEET OF SEVENTH ST. BRIDGE

neer, but the city art commission, to which the design was submitted, rejected it as esthetically inadequate.

Upon organization of a department of public works by the county, early in 1924, the voters approved a bond issue of $29,000,000 for new bridges and roads, and the department promptly proceeded to plan actively for the reconstruction of the three bridges in question. Numerous plans were prepared, for different types of structure, and the art commission was asked to review them and indicate its preference. It reported that it preferred a structure of suspension type for all three

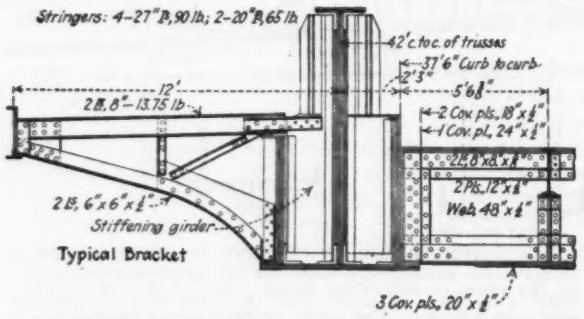


FIG. 3—CONNECTION OF FLOOR AND STIFFENING GIRDER
The three-web box girder forms the stiffening member as well as the anchorage of the suspension chain.

sites. Thereupon the engineering division restudied the bridge sites with a view to adapting the suspension type. As a result, it selected the self-anchoring type of suspension bridge.

Past experience has indicated, it is stated, that suspension bridges in Pittsburgh are subject to slip of the anchorages. Rock is about 50 or 60 ft. below water. Space is not available for anchorages of the ordinary type of suspension bridge, as at both ends of the crossing in each of the three cases there are obstructions to carrying the cables to a satisfactory land anchorage. On the north side of the river a railroad track passes between abutment and shore pier, which would make it necessary to carry the cables over the track, while at the south end proposed wharf improvements interfere. It was therefore highly desirable to use a type of structure which would not require any portion of the main bridge to pass over the railroad track on the north side and through the contemplated improvements on the south side. In the adopted type, anchorages are eliminated by utilizing the stiffening girder of the structure as a compression member to resist the horizontal pull of the suspension chain. The end supports thus are subjected to vertical forces only.

In working out the self-anchored suspension bridge design, it was early decided that eyebar chains would be superior to wire cables, because of permitting easier connection to the stiffening member at the ends.

In order to have as little as possible of the structural steelwork above the roadway, it was decided to use a plate girder for the stiffening member. This girder as designed extends above the roadway surface about 3 ft., sufficient to give a separation between roadway and sidewalk.

General Dimensions—The span arrangement of the three crossings is indicated by the dimensions in the location map included in Fig. 1. The Sixth and Ninth St. bridges have a main span of 430 ft. and side spans of 215 ft. each, while the spans of the Seventh St. bridge are 12 and 6 ft. longer, respectively. The drawings herewith, Figs. 1 to 3, refer to the Seventh St. bridge, but apply with only minor variation of dimensions to the other two bridges. As shown, the chain sag for the Seventh St. bridge is about 54 ft. 4 in. and the height of tower above pier about 83 ft. 5 in. The chains are spaced 42 ft. transversely, to accommodate a roadway 37½ ft. wide between curbs. The sidewalks are cantilevered out. The roadway will take four lines of traffic (two lines of street cars and two lines of road vehicles).

Because of the large underclearance required at midspan (47.1 ft. above pool level on a width of 180 ft.) and the low level of property at the approaches, the bridge roadway has unusually steep grades—4.175 per cent from either end to a point near the center, where a vertical curve connects the two grades. The stiffening girder follows the roadway profile, and thus has a camber of slightly over 15 ft. between ends and center. Since the two stiffening girders also resist the pull of the chains, they constitute a double strut, 885 ft. long curved to a middle ordinate of 15 to 16 ft., carrying an endwise compression of about 10,000,000 lb. The entire weight of the suspended structure is available

for holding it down against any tendency to buckle under this condition. The vertical load imposed by the chains on each main tower reaches a maximum of about 6,000,000 lb.

The three-web construction of the stiffening girder is shown by two cross-sections (minimum and maximum) in Fig. 2, where the make-up of these sections also is indicated. The central web is 108 in. deep, and the two side webs 54 in. and 63 in. deep, respectively. The maximum girder section is 1,109.13 sq.in.

The chains will be made of heat-treated eyebars, of minimum yield-point 50,000 lb. per square inch and minimum ultimate strength 80,000 lb. per square inch. Each chain is made up of 8 and 9 bars alternating, the bars being 14 in. wide and of varying thickness up to 2 in. The maximum section, at the tower top, comprises 7 bars 14x1⅝ in. and 2 bars 14x1⅜ in., a total section of 229.25 sq.in.

The suspenders are attached to stirrups riveted to the vertical stiffeners of the stiffening girders. The floor construction comprises a simple floorbeam and stringer system carrying a concrete slab. Floorbeams and sidewalk brackets are riveted direct to the sides of the stiffening girders.

The bridges were proportioned for live-load equivalent to two 18-ton trucks and two 60-ton cars, together with a sidewalk live-load of 66 lb. per square foot. The total live-load is equivalent to 6,590 lb. per lineal foot of span. In proportioning the stiffening girders and cables, an impact factor of 16.9 per cent was applied to the live-load. The eyebars were proportioned for a unit stress of 27,000 lb. per sq.in.

What the Dawes Plan Means To Industry and the World

Some Extracts from Speeches By Hoover, Hughes and Young That Show How German Reparations Come Back To All of Us

A THOUSAND or more men in New York City on Dec. 11 tendered a dinner to Owen D. Young, chairman of the Board of the General Electric Co., in honor of his services on the so-called Dawes Commission, which last summer prepared the plan for reparations to be paid by Germany which has since been put into effect. At that dinner were given a number of notable speeches, too lengthy to abstract here, but some of the remarks so clearly indicated the importance of the reparations settlement to the world in general and to industry in particular that they are presented below.

How Industry Benefits — Secretary of Commerce Hoover sounded the keynote of the evening. He said in part:

While the adjustment [of the German reparations] primarily advances the welfare of the nations of Europe, it reaches far afield in the world. Unemployment and suppressed production anywhere in the world are in the long view a world loss. This restoration of confidence and hope and enterprise, this restoration of commerce, of productivity, and of employment, this relief of suffering in a great nation, is a world asset. As a people we also participate in its blessings. Some part of our growing demand for labor, some part of the increased prices already realized by our sorely distressed agriculture, have come from this restoration of economic vigor and hope in Europe. It is a great thing to have contributed so much of this achievement.

Some have doubted whether the enormous liabilities established under this settlement can be discharged. There are those who have contended that no great external contributions from one nation to another can be economically sustained. Without debating this question I may be permitted to offer one thought in this connection. The payments provided in such settlements must find their substance from production and economic services rendered. These international obligations are huge burdens, but in the course of years any burden shrinks in weight in proportion as the productivity of a nation grows. When the world keeps peace it doubles its international trade once in nearly every score of years. The advancement of science, of invention, and of industry has shown an unceasing contribution to the productivity of peoples. The burdens of the Napoleonic wars were at that time also debated as being insuperable. It was contended that the world would break down under them, and yet a score of years later they bore so lightly that their dangers were no longer discussed. Indeed the processes of industry and commerce are the cells which heal the injuries of the economic world. They cannot multiply in the noxious air of conflict and political uncertainty. The settlement to which our guest has contributed so much clears the atmosphere, and the magical multiplication of these cells will quickly provide the strength to meet the burdens—if the world keeps the peace.

But beyond even these special occasions of vivid public service, Mr. Young has made a still further contribution to American life—perhaps the greatest of all his contributions. That is in his display of the fine sense of the responsibility which today rests upon those who administer our largest industries.

Manufacture and distribution on a vast scale are the foundation of our high standards of living and the general comfort of our people. They can be accomplished in no other way than through the development of great units of production. With their development have come innumerable problems of public relationship and public responsibility. We are in fact today witnessing a rapid evolution and perhaps a silent revolution in the relationship of great business to our social system. We are struggling to preserve the fundamental stimulus of action, of initiative and competition, to hold open the avenues of opportunity. At the same time we are struggling to gain the benefits of co-operative action. In this period of evolution nothing is more needed than clear vision of their public responsibilities on the part of our industrial leaders. For here is a triple trusteeship—a trusteeship to the owners who ultimately must be comprised from the savings of those who endeavor to provide security for their dependents and for their old age; the trusteeship for a vast body of employees that they should have stability in employment and a sense of security for work conscientiously performed, that they should have a growing standard of living and comfort, and full opportunities for recreation and education; and an equal trusteeship to the whole public who are served by the products of these enterprises. It is in the public interest that the product should be multiplied; should be given with every advantage of technical excellence and service and upon the best terms which can be attained with due regard to the two other strong obligations toward which our leaders must also look. This trusteeship goes even further. Constant gains to each group depend upon the elimination of waste and the constant development of science and invention, of increasingly efficient organization. Beyond this again these organizations must be held high in the business and ethical relations by the character of their leaders. They must be conducted in a fine sense of non-interference with human rights.

I know of no responsibility larger than that imposed upon the leadership of great industries, for from their leadership and their vision must come not only great contributions to our economic progress but upon it depend the solution of the many social problems which confront us. We have a real and growing measure of this sense throughout American industry. And Mr. Young has been the expression of this type of leadership.

What the Expert Does—Secretary of State Hughes contributed the following pertinent thought:

The greatest difficulty that we have in making democratic institutions work is in securing play for expert ability. Paradoxical as it may seem, we are too often overpowered by feebleness. In this instance talent has had opportunity,

not to determine but to advise, not to bind governments but to inform them.

But we can always enlist the service of expert advice, and, after all, despite our seeming neglect of it, there is no more compelling force than sound opinion. One great obstacle is that rarely is advice demonstrated disinterestedly. In this expert study of the economic problems of Europe, we have had recognized competence backed by relative disinterestedness of the United States. Nothing could be more persuasive than that.

An Economic Program—Finally, Mr. Young made this plea to the people of the United States to support the plan:

The restoration of Germany is not an end in itself; it is only a part of the larger problem of the reconstruction of Europe. It is not German credit and German currency alone which need to be restored in order that financial stability may return to the world. Our low bank rates and our greatly increased gold supply will, if used wisely, enable us not only to aid our neighbors but to help ourselves. By restoring foreign credits we will increase our export markets, particularly for our excess food supplies; by stabilizing foreign currencies we will restore throughout the world the free flow of commodities, including gold. When that shall have been done we shall hear less in this country, and rightly so, of artificial price levels and arbitrary bank rates.

The plan cannot succeed without the co-operation of the people of America. Have we at last realized the responsibilities which are the counterpart of our own riches? The plan is an economic program. It is not a political one. It requires for its execution the continued economic support of the United States. It does not require any direct political support or involve any political entanglement.

Our agencies of business must all co-operate in support of the plan. Our men of commerce, industry, agriculture and finance, including the Federal Reserve System, must aid in the restoration of the credit and currencies of the principal commercial nations. We may debate political participation in the affairs of the world as we will, but we must participate in its business, and business, like science, knows no political boundaries and in its dictionary there is no such word as isolation.

Preliminary Road Traffic Counts in Pennsylvania Survey

Figures Cover Winter Period—Truck Passenger Car Ratios—Winter Night Travel—Weekly and Daily Variation

Early figures gained from the highway traffic survey in Pennsylvania were given at the meeting of the American Society of Civil Engineers at Detroit, Mich., Oct. 23-24, by W. A. VanDuzer, Equipment and Transport Engineer, Pennsylvania Highway Department. The objects and general procedure of this survey were outlined in Engineering News-Record, July 17, 1924, p. 98. Only the actual findings given by Mr. VanDuzer are, therefore, presented at this time. For a comparison the reader will find the conclusions of the Connecticut and the California surveys in Engineering News-Record, March 27, 1924, p. 526.—EDITOR.

THE AVERAGE daily densities of trucks and passenger cars for every day from Nov. 1 to April 30, inclusive, at 103 stations in the southeastern part of Pennsylvania (Division 1) is 1,292 vehicles per day. The northeastern section of Pennsylvania (Division 3) has an average winter density of 679 vehicles per day at 62 stations. The heaviest station in Division 1 has an average daily winter density of 897 trucks and 5,794 passenger cars. April Thursdays or Fridays average 1,118 trucks at this station, and April Sundays average 23,180 passengers cars. In Division 3 at the heaviest station a maximum day would see 5,712 passenger cars and 316 trucks. This maximum day would be Sunday for passenger cars, and Wednesday for trucks.

There are 7.1 passenger cars on the road for every truck in Division 1. In Division 3 there are 10.2 passenger cars per truck. In Connecticut the number of passenger cars per truck during winter months was found to be 3.7. The respective registrations in the two states are:

	Passenger Cars	Trucks	Passenger Cars per Truck
Connecticut	152,608	29,140	5 2
Pennsylvania	969,361	74,409	13 0

It will be noted that the ratio of passenger cars to trucks in the winter months for both Connecticut and Pennsylvania is less than the ratio of registrations in those states. In summer there were found to be 6.8 passenger cars per truck in Connecticut, and we may expect to find about 17 passenger cars for every truck on the Pennsylvania roads in summer.

Between 8 p.m. and 6 a.m., there is observed about 4.7 per cent of the daily trucks and 21.9 per cent of the daily passenger cars. The two peak hours of the day are 10 a.m. and 2 p.m. for trucks, and 5 p.m. and 8 p.m. for passenger cars. Trucks climb rapidly from a minimum of 5 per cent of the average hour at 2 a.m. to 220 per cent of the average hour at 10 a.m. There is then a fall of 181 per cent for the hour from 12: 00 to 1: 00 p.m. and another sharp rise to 228 per cent at 2 p.m. By 8 o'clock in the evening there are but 11 per cent of the number of trucks observed in the average hour. Passenger cars rise slowly from a minimum of 4 per cent at 4 a.m. to 120 per cent at noon. After noon there is a sharp continuous rise to 229 per cent of the average hour at 5 p.m. At 7 o'clock there are 126 per cent, and at 8 o'clock 146 per cent of the passenger cars at the average hour. After 8 p.m. the decline is slow but steady to the minimum at 4 a.m.

Actual count at two of the heaviest stations in Division 2 showed 130 trucks and 1,152 passenger cars at the maximum hours. Both these figures were within 9 per cent of the computed maxima, obtained from a study of the whole division. It should be recalled that all figures given here are for the months from November, 1923, to April, 1924, inclusive.

Variation by days of the week has been measured in two divisions with the results shown in the following tabulation. The figures are in per cent of the average day of the week:

	Passenger Cars		Trucks	
	Division 1	Division 3	Division 1	Division 3
Monday	85	68	119	104
Tuesday	73	64	116	112
Wednesday	78	73	190	120
Thursday	84	88	121	115
Friday	82	78	121	116
Saturday	111	109	96	115
Sunday	188	221	17	17

Of the six months from November to April, inclusive, April is the highest month for both passenger cars and trucks in all but one of the Pennsylvania divisions. The single exception is in Division 3, where November is slightly higher than April for passenger cars, and March is a little higher than April for trucks. In California the months of November and April were very nearly equal.

Cost of Constructing Mersey Tunnel

The British government has offered £2,375,000 toward the total estimated cost of £7,250,000 for constructing a tunnel under the River Mersey, between Liverpool and Birkenhead and Wallasley. The Merseyside Co-ordination Committee considers this sum inadequate and the government will be approached to increase it. The total cost covers land and property charges and interest on money outstanding. The government is concerned only with the construction cost. The tunnel will form a valuable mercantile highway between the various centers in the north of England. At the present time all merchandise has to be carried by horse wagon or trucks to Birkenhead and then ferried across the Mersey. An average of 2,500 vehicles are carried across daily, and the present system has involved considerable congestion. The engineers who have prepared tentative plans have designed their tunnel to carry four rows of vehicles in the upper division, and two lines of tramways in the lower, the total length of the tunnel being 2,400 yards.

A Method for Comparing Sprinkler Nozzle Performance

The Application of Data Obtained by Testing Circular Sewage Sprinkler Nozzles Under Constant Heads to Any Condition of Variable-Head Operation

By Maurice J. Zucrow
Research Assistant, Purdue University, Lafayette, Ind.

In trickling filter practice where stationary sprinkler nozzles are used for discharging sewage over a filter, the head under which these nozzles are operated is rarely constant but varies according to some predetermined plan. The head which acts upon such a nozzle at any instant, when in operation, depends primarily upon the following two main factors: (1) The head lost in the pipe system leading from the dosing chamber up to the nozzle. (2) The method and apparatus used to control the rate of sewage discharge to the pipe system.

The manner in which the head lost in the pipe system will vary as the sewage discharge varies depends mainly upon the size, length, and age of the pipes conducting the sewage to the nozzles. It is readily seen that this feature is peculiar to each individual sewage-works. It may be noted that where butterfly valves are used for control, the head in the dosing channel is practically constant.

The type of apparatus used for controlling the rate of sewage discharge is the most influential factor in determining the manner in which the head on the sprinkler nozzles will change from instant to instant. The selection of the type of apparatus used for dosing a trickling filter is governed by many different factors which generally are local in character. If the fact is kept in mind that each sewage-works is designed to meet the requirements of its own specific problem, and that the apparatus used in one works and the manner of varying the head acting on the nozzle are inextricably tied in with the solving of the particular problem in hand, it becomes apparent that, due to these local exigencies, it is doubtful if the nozzles of any two sewage-works would be operated under identical conditions of head variation.

Hence, from a consideration of the two factors previously mentioned, one may not find the same type of stationary nozzles of two different trickling filters being operated under similar laws of head variation. This fact leads to the question, how should these nozzles be tested so that the data obtained will be of general value and applicability? Obviously, even if conditions in practice could be reproduced in the hydraulic laboratory, the results of such tests would necessarily be restricted in their application to works where the law of variation of the head acting on the nozzle at any time followed exactly that of the experimental case. Such data would not be very useful, their range of application would be too limited, they would not be fundamental. Aside from this, actual conditions in practice are extremely difficult to duplicate in the laboratory, and from this last point of view alone, it would hardly be advisable to test these stationary sprinkler nozzles under a condition of variable head.

To obviate the difficulties discussed in the preceding paragraphs, these nozzles can be tested under conditions of different constant heads. Data obtained this way are fundamental; they tell exactly how a given nozzle will perform when operated under any specific head. Moreover, the greater degree of accuracy obtainable in measurements makes this method of testing nozzles decidedly practicable from a laboratory point of view. The object of this discussion is, therefore, to indicate how data obtained by testing these stationary nozzles under different constant heads may be applied to any condition of variable-head operation. It should be understood that the method described is applicable to circular nozzles only.

It is assumed, then, that for a given nozzle the constant-head discharge data are available, but it is also necessary to know the relationship between the head on the nozzle at any constant and the time elapsed between successive changes in head. This should preferably be available in the form of a curve showing the head on the nozzle, h, plotted as ordinates against

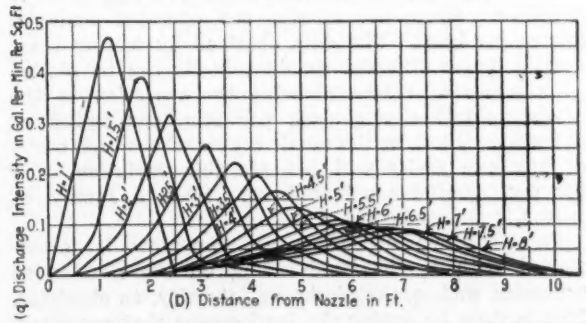


FIG. 1—RELATION BETWEEN q AND D FOR DIFFERENT CONSTANT HEADS ON SEWAGE-SPRINKLER NOZZLE
Performance curves for nozzle P.G.S.

the time, t, as abscissas. For convenience, the abscissa value $t = 0$ should have for its corresponding ordinate the value $h = h_{max.}$, the highest head under which the nozzle is operated. Such a curve for any nozzle will be referred to as its "head-time" curve or "h—t curve."

The shape of the h—t curve is governed by the condition of operation to which the nozzle is subjected and the head losses in the pipe line up to the point where the nozzle is located. This curve can be determined experimentally if necessary, and in the cases of "siphonic discharge" and with certain types of mechanically operated valve control it can be determined mathematically with a fair degree of accuracy. The point to bear in mind is that the h—t curve for the nozzle of one sewage-works will rarely be duplicated in other works.

The discharging capacity of a sewage nozzle can be computed approximately, but it should be determined experimentally. Data regarding the discharging capacity of certain nozzles may be found in Bulletin No. 3 of the Engineering Experiment Station of Purdue University, entitled, "Coefficients of Discharge of Sewage Sprinkler Nozzles" by Prof. F. W. Greve and W. E. Stanley.

Assuming, then, that the additional information just discussed is available, attention will now be turned to the main problem, which is the transformation of these constant-head data, by so using them and this addi-

TABLE I—RELATION BETWEEN HEAD AND TIME

Head in Feet			Time in Minutes		
h_1	h_2	$h_{av} = \frac{h_1 + h_2}{2}$	t_2	t_1	$t_2 - t_1$
8	7.8	7.9	0.3	0.	0.3
7.8	7.6	7.7	0.7	0.3	0.4
7.6	7.4	7.5	1.0	0.7	0.3
7.4	7.2	7.3	1.4	1.0	0.4
7.2	7.0	7.1	1.7	1.4	0.3
7.0	6.8	6.9	2.1	1.7	0.4
6.8	6.6	6.7	2.5	2.1	0.4
6.6	6.4	6.5	2.8	2.5	0.3
6.4	6.2	6.3	3.2	2.8	0.4
6.2	6.0	6.1	3.6	3.2	0.4
6.0	5.8	5.9	4.0	3.6	0.4
5.8	5.6	5.7	4.4	4.0	0.4
5.6	5.4	5.5	4.8	4.4	0.4
5.4	5.2	5.3	5.2	4.8	0.4
5.2	5.0	5.1	5.6	5.2	0.4
5.0	4.8	4.9	6.1	5.6	0.5
4.8	4.6	4.7	6.5	6.1	0.4
4.6	4.4	4.5	7.0	6.5	0.5
4.4	4.2	4.3	7.4	7.0	0.4
4.2	4.0	4.1	7.8	7.4	0.4
4.0	3.8	3.9	8.3	7.8	0.5
3.8	3.6	3.7	8.7	8.3	0.4
3.6	3.4	3.5	9.2	8.7	0.5
3.4	3.2	3.3	9.7	9.2	0.5
3.2	3.0	3.1	10.3	9.7	0.6
3.0	2.8	2.9	10.8	10.3	0.5
2.8	2.6	2.7	11.4	10.8	0.6
2.6	2.4	2.5	12.1	11.4	0.7
2.4	2.2	2.3	12.8	12.1	0.7
2.2	2.0	2.1	13.4	12.8	0.6

tional information as to make these data applicable to conditions when the nozzles are operated under a fluctuating head. The data obtained by testing these nozzles under different constant heads can be plotted as a series of curves showing the variation in the discharge intensity q (gal. per min. per sq.ft.) at different radii from the nozzle center where each curve of any one series will indicate this variation of q for one specific constant head. Such a family of curves is shown in Fig. 1.

These aforementioned curves can now be cross-plotted with h, the head acting on the nozzles, as ordinates, and, q, the discharge intensity, as abscissas. This is done by noting the head curves that are intersected by perpendiculars erected at different values of D, the distance from the nozzle, and also noting the value of q at the points of intersection. If such perpendiculars are erected at regular intervals of, say, every ½ ft. out from the nozzle, and the necessary information just mentioned is recorded, another family of curves can be plotted from the initial performance curves that will show how the discharge intensity q varies with the head at different fixed distances, D, from the nozzle. Such a series of curves is shown in Fig. 2. From these cross-plotted curves the values of the discharge intensity, q, at the different distances from the nozzle that the spray is caused to fall when operated under any specific head, can be determined.

It must be quite obvious that any particular head which acts on a nozzle operated under a variable-head condition acts for only an instant and its value changes. In fact, in the usual case, the exact length of time that any one head is acting on the nozzle is an infinitesimal.

Referring now, to the h—t curve, such as that shown in Fig. 3, if one considers the time required to accomplish a small head change, and then assumes that the nozzle was operated during this time interval under a head which is the average of the initial and final heads acting during this time interval and proceeds in this manner for the entire curve—from the maximum value of h to its minimum value—one can substitute for the actual existing conditions, without introducing too large an error, a table of average heads and corresponding time intervals for which they are assumed to act on the nozzle. Of course, this is only approximately true at best, for, as already stated, actually the head on the nozzle is never constant. The degree of accuracy obtainable by this analysis depends entirely upon the size of the increments into which the h—t curve is subdivided. Table III was obtained from the h—t curve of Fig. 3 by this method.

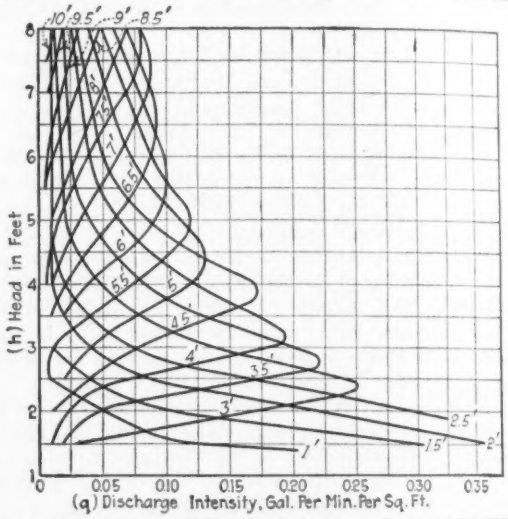


FIG. 2—RELATION BETWEEN h AND q FOR DIFFERENT CONSTANT DISTANCES FROM NOZZLE

Turning now to Fig. 2 where the relationship between q and h is expressed by the series of curves derived by cross-plotting the curves of Fig. 1, if one notes the curves intersected by lines representing the values of the average heads listed in Table I, and if one records the distances from the nozzle axis and the corresponding values of the discharge intensity determined by the points of intersection, a table can be compiled which lists the discharge intensity q at different distances out from the nozzle. It is best to have these distances differing by equal increments and the table should be drawn up to cover all of the heads given in Table I. The new table will be referred to as Table II.

If each value of q listed in Table II is multiplied by

TABLE II—DISCHARGE IN GALLONS PER MINUTE PER SQUARE FOOT

h_{av}	Distance From Nozzle in Feet									
Ft.	1	2	3	4	5	6	7	8	9	10
7.9		0.01	0.01	0.03	0.04	0.06	0.08	0.07	0.03	0.01
7.7		0.01	0.01	0.03	0.04	0.07	0.09	0.06	0.03	0.01
7.5		0.01	0.01	0.03	0.05	0.07	0.09	0.06	0.02	0.01
7.3		0.01	0.01	0.03	0.05	0.07	0.09	0.05	0.02	
7.1		0.01	0.02	0.03	0.05	0.08	0.09	0.05	0.02	
6.9		0.01	0.02	0.03	0.06	0.07	0.08	0.05	0.02	
6.7		0.01	0.02	0.04	0.06	0.08	0.08	0.05	0.02	
6.5		0.01	0.02	0.04	0.06	0.09	0.08	0.04	0.01	
6.3		0.01	0.02	0.04	0.07	0.09	0.07	0.04	0.01	
6.1		0.01	0.02	0.04	0.07	0.10	0.07	0.03	0.01	
5.9		0.01	0.02	0.04	0.08	0.10	0.06	0.03	0.01	
5.7		0.01	0.02	0.04	0.08	0.10	0.05	0.02	0.01	
5.5		0.01	0.02	0.05	0.09	0.10	0.05	0.02	0.01	
5.3		0.01	0.02	0.05	0.10	0.10	0.04	0.02		
5.1		0.01	0.02	0.06	0.11	0.09	0.04	0.01		
4.9		0.01	0.02	0.07	0.12	0.09	0.03			
4.7		0.01	0.03	0.08	0.13	0.08	0.02			
4.5		0.01	0.03	0.09	0.13	0.07	0.02			
4.3		0.01	0.04	0.10	0.13	0.06	0.02			
4.1		0.01	0.04	0.12	0.12	0.04	0.01			
3.9		0.01	0.05	0.13	0.11	0.03				
3.7		0.02	0.07	0.15	0.09	0.03				
3.5		0.02	0.08	0.17	0.08	0.02				
3.3		0.03	0.10	0.19	0.06					
3.1		0.04	0.12	0.19	0.05					
2.9		0.05	0.15	0.16	0.04					
2.7		0.06	0.20	0.12	0.03					
2.5	0.01	0.08	0.24	0.07	0.02					
2.3	0.02	0.13	0.25	0.04						
2.1	0.04	0.20	0.20	0.03						

TABLE III—DISCHARGE IN GALLONS PER SQUARE FOOT

h_{av} Ft.	Distance From Nozzle in Feet									
	1	2	3	4	5	6	7	8	9	10
7.9		.003	.003	.009	.012	.018	.024	.021	.009	.003
7.7		.004	.004	.012	.016	.028	.036	.024	.012	.004
7.5		.003	.003	.009	.015	.021	.027	.018	.006	.003
7.3		.004	.004	.012	.020	.028	.036	.020	.008	
7.1		.003	.006	.009	.015	.024	.027	.015	.006	
6.9		.004	.008	.012	.024	.028	.032	.020	.008	
6.7		.004	.008	.016	.024	.032	.032	.020	.008	
6.5		.003	.006	.012	.018	.027	.024	.012	.003	
6.3		.004	.008	.016	.028	.036	.028	.016	.004	
6.1		.004	.008	.016	.028	.040	.028	.012	.004	
5.9		.004	.008	.016	.032	.040	.024	.012	.004	
5.7		.004	.008	.016	.032	.040	.020	.008	.004	
5.5		.004	.008	.020	.036	.040	.020	.008	.004	
5.3		.004	.008	.020	.040	.040	.016	.008		
5.1		.004	.008	.024	.044	.036	.016	.004		
4.9		.005	.010	.035	.060	.045	.015			
4.7		.004	.012	.032	.052	.032	.008			
4.5		.005	.015	.045	.065	.035	.010			
4.3		.004	.016	.040	.052	.024	.008			
4.1		.004	.016	.048	.048	.016	.004			
3.9		.005	.025	.065	.055	.015				
3.7		.008	.028	.060	.036	.012				
3.5		.010	.040	.085	.040	.010				
3.3		.015	.050	.095	.030					
3.1		.024	.072	.011	.030					
2.9		.025	.075	.080	.020					
2.7		.036	.012	.072	.018					
2.5	.07	.056	.017	.049	.014					
2.3	.014	.091	.018	.028						
2.1	.028	.014	.014	.021						

the time that the head causing it is assumed to act (which time is given in Table I) the discharge in gallons per square foot at different distances from the nozzle will be obtained. The sum of the discharges due to the different heads contributing to the liquid collected at any one distance from the nozzle represents approximately the discharge in gallons per square foot at that point for a head fluctuation from the maximum to minimum head on the nozzle.

These total discharges at different distances from the nozzle can be plotted on graph paper to give a curve showing how the sewage from the nozzle is distributed over the filter for the head limits under consideration, and for the particular manner of head variation. The curve would show discharge in gallons per square foot plotted against distance from the nozzle. Such a curve will reveal at a glance the degree of uniformity of distribution of the liquid, over the

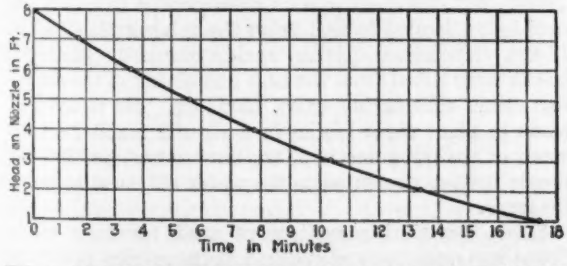


FIG. 3—RELATION BETWEEN t AND h FOR NOZZLE P.G.S.

filter, that can be expected with the nozzle under consideration, when it is operated under the particular condition of variable-head determining the h—t curve used in making the computations to determine the nozzle's performance. (See Fig. 4.)

The accuracy of the quantitative results obtained by using this method of analysis depends entirely on the size of increments into which the h—t curve is subdivided, and where a high degree of accuracy is necessary, this procedure is quite laborious. However, for the comparison of the relative merits of different nozzles, the increments need not be taken so closely together, and this method of analysis serves as a ready means of comparing different nozzles when placed under the same conditions of head operation.

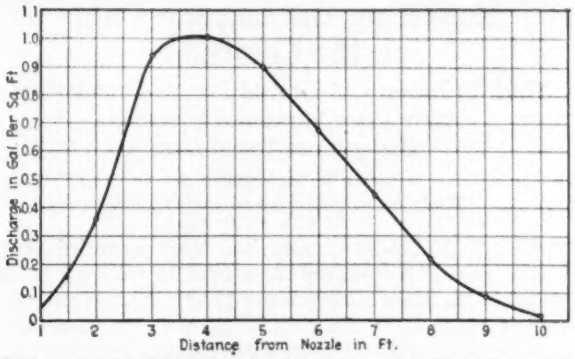


FIG. 4—DISTRIBUTION OF SPRAY IN GALLONS PER SQ.FT. ON A RADIUS VECTOR FOR NOZZLE P.G.S.

The data used in this discussion were obtained from recent investigations on sprinkler nozzles conducted by the Hydraulic Section of the Engineering Experiment Station of Purdue University. The results of these investigations are to be published shortly in bulletin form.

High Early Strength Cement From Titaniferous Ores

AN EARLY high strength cement with a titaniferous iron ore base has been suggested by Edwin C. Eckel, mineral geologist, Washington, D. C., in a patent recently issued to him. The process and the cement are described as follows:

Some of the iron ore deposits in various parts of the world are too high in titanic oxide for the economical production of iron because of the excessive fuel cost of smelting them. These titaniferous ores are low in sulphur and phosphorus, and there is an incentive in their use in producing iron provided a profitable method can be developed. The utilization of this iron ore as a constituent of cement offers such a method because it develops a cement singularly free from excessive amounts of silica, which is detrimental to alumina cements.

The fusion of limestone with this titaniferous ore at 1,400 to 1,500 deg. F. produces an unusually pure metallic iron and a new type of cement slag. This slag, containing all the lime of the fusion, any alumina that may have been present in it, and between 2 and 10 per cent of the iron oxide, makes, when ground to a fine powder, the new so-called "titan" cement.

The titan cements, says Mr. Eckel, possess valuable properties. If the lime constituent is kept below 50 per cent, and with most mixes preferably around 30 to 40 per cent, the cement hardens, after a normal set, with extreme rapidity and attains very high strength in 24 to 48 hours. The gain in strength at later periods is at a somewhat lower rate, but the strength is at all times far above that of portland cement. The strength of the titan cement can be controlled by varying the lime-acid ratio, and the setting time seems to be determined by the method of cooling and by the percentage of the titanic iron oxide retained in the fusion. An important difference between the titan cement and previous alumina cements is that the titan cement has a greater specific gravity, of 3.35 to 3.55, with a resultant advantage of increasing the density of the concrete in which it is used. The titan cement also shows greater resistance to chemical attack than portland cement or previous alumina cements.

Repairing the Laguna Dam on the Colorado

Work to Restore 15-Yr.-Old Porous-Foundation Weir After Shortened Channel Undermines Toe of Dam

By R. M. Priest
Engineer, U. S. Bureau of Reclamation, Yuma Project, Yuma, Ariz.

FOUR-TON blocks of concrete, large quarried rock and run of the quarry were used to fill deep holes eroded in the talus aprons below the sluiceways and toe of the Laguna Dam of the U. S. Bureau of Reclamation on the Colorado River, near Yuma, Ariz. This dam, or weir, is one of the few examples of the so-called Indian type of porous-foundation overflow dams in the United States. It consists of three concrete walls across the river, resting on sand bottom, with the intervening space filled with dumped rock, which is covered with a concrete pavement. The repairs, which were completed in February, comprise the only maintenance on this dam after fifteen years of service. The cost is equivalent to 0.4 per cent per year of the original cost.

At the height of the 1920 summer flood, which reached a peak flow of 190,000 sec.-ft., the river cut across a large bend at a point 5 miles below Laguna Dam, shortening the distance by river some 6 miles. One of the characteristics of the Colorado River is to maintain a slope of 1.2 ft. per mile between any two given points regardless of the distance; therefore, when this shortening took place retrogression immediately started to restore equilibrium. Since retrogression must cease at the toe of the dam, the accumulation of this lowering amounted to 7 ft. in the water surface in the river at the toe of the dam in a period of three years. In consequence a direct drop of the water off the apron or talus at the toe of the dam resulted and since the dam is constructed on a sand foundation this over-pour could not be allowed to continue in view of the fact that a large quantity of the talus or apron rock had been washed away and holes along the lower concrete core wall showed depths below the bottom of this wall. A board of consulting engineers recommended filling these holes and extending the talus for 95 ft. downstream from the lower wall with the best rock procurable. The original talus was only 50 ft. in width.

This same retrogression similarly affected the outlets of the sluiceways and although the outlets are in rock it is of poor quality and is subjected to velocities as high as 30 ft. per second during sluicing periods. Holes to a depth of 26 ft. had developed just off the concrete aprons.

On account of the high velocities, it was decided for the California sluiceway, which has a carrying capacity of 22,000 sec.-ft., to make concrete blocks of 2 cu.yd. each, place them in the sluiceway channel to an elevation equal to that of the concrete apron and to extend the work downstream for a distance of 95 ft. As the outlet of the Arizona sluiceway, being but one-third the size of the California sluiceway, is not subjected to as much erosion, it was believed that large rock would answer the purpose there.

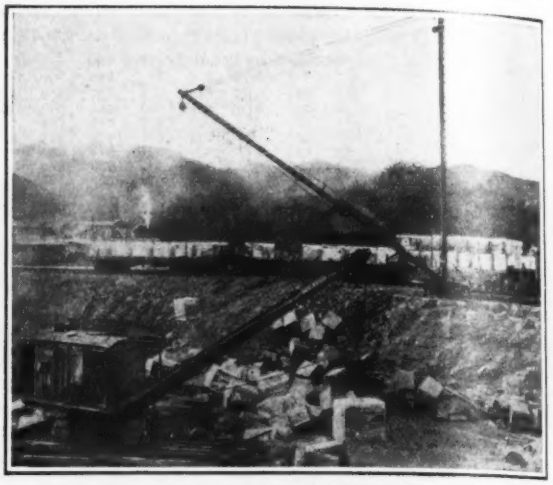


FIG. 2—PLACING CONCRETE BLOCKS IN CALIFORNIA SPILLWAY
Blocks handled from cars to place by derrick and dragline.

Concrete Blocks Used—The repairs to the California sluiceway were made first, 730 blocks being cast and placed with a derrick having a 60-ft. boom. For the area that could not be covered with the derrick a dragline was used. The blocks were cast on standard flat cars using sixty collapsible bottomless forms, made up of 1 and 2-in. lumber. The forms were stripped the day after concrete was poured and were set up again. Twelve 3 x 4 x 4½-ft. blocks were poured to a car, the cars being hauled to and from the mixing plant by an 18-ton locomotive. After curing for four days the blocks were lifted from the cars and placed in the sluiceway, thus eliminating extra handling. No effort was made to place these blocks in a regular manner on account of the irregularity of the bottom and, besides, the rough surface presented to the water will tend to break its force.

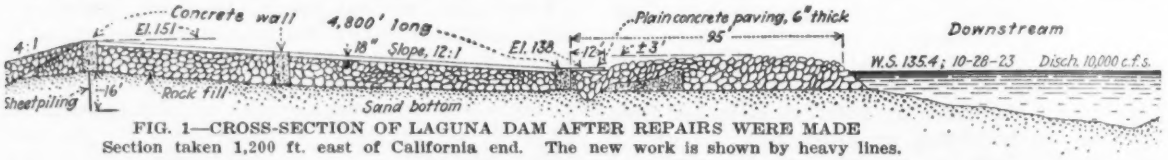


FIG. 1—CROSS-SECTION OF LAGUNA DAM AFTER REPAIRS WERE MADE
Section taken 1,200 ft. east of California end. The new work is shown by heavy lines.

Seven sacks of cement were used for each block. Stone was quarried and crushed at the mixing plant and sand was hauled in 12-yd. dump cars from Yuma by

FIG. 3—CONCRETE BLOCKS CAST AND CURED ON CARS

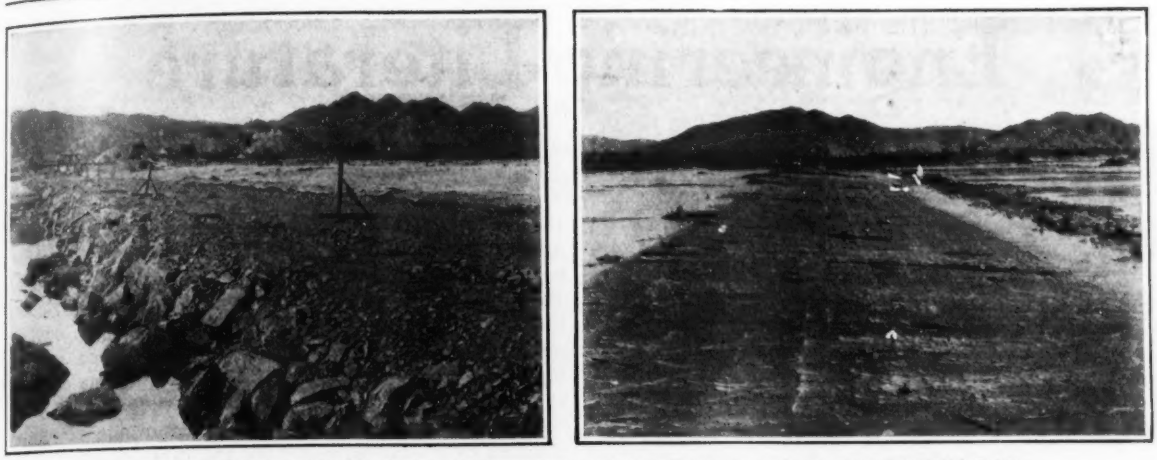


FIG. 5—REPAIRS ON THE TALUS APRONS BELOW THE SLUICEWAYS OF THE LAGUNA DAM

Left—Lower side of talus after completion of fill; run of quarry rock placed with side-dump cars, the track being moved sidewise a little at a time. Right—Completed talus after eight months' service; smooth water just ahead of talus is over new pavement slab downstream from the lower cutoff wall.

railroad. The blocks were handled by loops made from scrap cable, that had been worn out in dragline machines, cast in place in the block. A maximum of fifty blocks was cast in one day. These blocks have been in place since February, 1924, and with the exception of some little settlement, which was expected, have proved satisfactory. It might be added that the average annual

FIG. 4—BLOCKS IN CALIFORNIA SLUICEWAY AFTER EIGHT MONTHS' SERVICE

No attempt was made to place blocks in regular positions; the irregularity was counted on to break up velocity.

sluicing is about 1,500 hours, done for 24 hours each week, and that during the period of repairs to the toe of the dam the sluice gate was open and the work done was subjected to what equaled a years' sluicing under normal conditions.

Repairing the Talus—For the repairs to the talus at the toe of the dam rock was procured from a quarry on the Arizona side as it is of much better quality than that on the California side of the dam. Railroad connection at the dam is had on the California side over the Potholes Branch of the Southern Pacific Ry., connecting with the main line at Yuma. All equipment and supplies for the work in hand were hauled over this branch line with government equipment. A standard-gage track connecting with the branch line was laid across the dam to the quarry on the Arizona side. The steam shovel had been moved across the river when a flood from the upper river caused by heavy rains reached greater volume than could be handled by the sluiceways. This flood necessitated the removal of the railroad track from the dam and suspension of work for a week, when the flood waters subsided and the track was relaid. A steam shovel, two 18-ton locomotives, and twelve 12-yd. side-dump cars were used in handling the rock. Two 3-car trains were used in hauling the rock, the track being thrown over a few feet at a time until the full width of 95 ft. from the lower core wall was reached. The throwing of the track was a difficult matter on account of the large rocks over which it had to be moved. A total of 33,700 cu.yd. of rock was placed in this manner. Two shifts of eight hours each were worked so as to complete the work in the shortest possible time.

The flowing prism of the dam had contracted to a length of 1,500 ft. due to the accumulation of debris which had silted in. This length of crest was increased to 2,000 ft. by excavating 25,800 cu.yd. of silted-in debris with two draglines. Pavement, 12 ft. wide and 6 in. thick, was laid for 2,000 ft. along the lower core wall in an effort to cause the water leaving the dam to flow along the same plane as that of the river and to prevent the tendency to scour out holes just off this wall. In laying this pavement only the smaller material was removed to get the required thickness of concrete; all large stones were left in place and the concrete poured around them. This method has proved satisfactory. Near the Arizona side of the dam, where the original paving of the face of the dam was made with large rock, a considerable amount of deterioration which had taken place was repaired with concrete. The Arizona sluiceway channel retaining walls had become undermined in places requiring deposition of a considerable amount of concrete under water. In all 532 cu.yd. of concrete were poured outside of the 1,460 cu.yd. in the 2-yd. blocks placed in the sluiceway.

The work done has been satisfactory. It is surprising the small amount of filling in that will be necessary considering the fact that run of the quarry was used. No effort was made to pick the rock as this would have been impracticable on account of the short time available to complete the job, besides desirable rock for this class of work is hard to procure in this vicinity and the equipment available was not suitable.

The repairs were made under the general direction of Porter J. Preston, superintendent of the Yuma project, with the writer in direct charge.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Fluid Friction and Chemical Pumping

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

THE MODERN THEORY AND PRACTICE OF PUMPING: A Treatise on the Application of the Reynolds-Stanton Law of Viscous Flow to Modern Pumping Problems and the Flow of Liquids Through Pipes—By Norman Swindin, M.I.Chem.E., A.M.I.Mech.E. New York: D. Van Nostrand Co. Cloth; 7 x 10 in.; pp. 364; 279 figures. $10.

This is essentially two books in one: The first hundred pages relate to the theory of fluid friction and contain a timely correlation of recent researches on fluid friction, including particularly the work of Osborne Reynolds, Rayleigh and Stanton and Pannell. The remaining 253 pages deal with the theory and practice of pumping, but with special reference to the problems of handling corrosive or viscous fluids encountered in chemical works.

Many of the early investigators assumed that the fluid friction formula should be of the form

$$R = av + bv^2,$$

the first right hand term corresponding to lamellar flow in accordance with Poiseuille's law, the second corresponding to turbulent flow. The author states that Osborne Reynolds was the first to show that the change from lamellar to eddying motion took place suddenly at a definite velocity called the critical velocity. The idea of sudden change from wholly lamellar to completely turbulent flow may be considered as the author's first proposition. His second proposition is that fluid friction is a function of kinematic viscosity. As to the truth of the latter proposition, recent experiments leave little doubt, nor is there any doubt that a change in some degree from lamellar to turbulent motion takes place at the Reynolds critical velocity. Proceeding on the basis of the two propositions stated, the author enthusiastically describes the important experimental researches of Stanton and Pannell and apparently concludes that the subject of fluid friction is now completely understood. It is doubtful if all hydraulicians are ready to accept the conclusion that all the difficulties hitherto supposed to exist in relation to the theory and practice of fluid friction are now disposed of in a satisfactory manner. Mr. Swindin apparently overlooks some very important experimental work done in America within the past twenty or thirty years, the results of which do not sustain his asseveration that "between 1883 and 1911 there was a blank." For example, the experiments of Saph and Schoder and the accompanying discussion thereon, published in 1903, seemed to the reviewer to throw important light on the very questions considered by Swindin.

The first chapter contains an excellent though incomplete review of the development of knowledge of pipe friction. Chapter 2, on viscosity and practical viscometry, contains matter generally available to engineers, if needed, in standard treatises. Chapter 3, relating to the flow of viscous fluids, contains a full and acceptable account of Osborne Reynolds' experiments interpreted in the light of Rayleigh and Stanton's researches. Chapter 4, on fluid friction in pipes, similarly presents the results of the experiments of Stanton and Pannell and emphasizes the importance of kinematic viscosity as a fundamental factor in fluid friction formulas. Equations of the Stanton experimental curve, developed by Lees and Lander, are given. The velocity of course appears twice—first in the v^2 term and also in the kinematic viscosity term. In the latter it has a fractional exponent.

Stanton's experiments cover a wider range of conditions as to pressures, velocities and types of fluids than any hitherto performed. Formulas agreeing with these experiments and incorporating kinematic viscosity as a variable represent an important step in advance in relation to practical hydraulics.

While it should be taken with some reservations, the first part of the book relating to fluid friction presents an orderly review of certain important researches on this subject which will be interesting and profitable reading for most engineers having to do with hydraulics.

In the second and third parts of the book a wide variety of pumping apparatus is described, including ram, centrifugal, rotary, air-lift and displacement pumps. Numerous illustrations are included, some of which will be novel to engineers who have had to do mainly with the pumping of water. Most of the illustrations relate to adaptations of standard types of pumps to meet the special conditions involved in chemical pumping. Some attention is given to efficiency and to the application of the viscosity theory. Only in the case of the air-lift pump is there an extensive theoretical discussion. This is accompanied by detailed examples of design. The second part of the work is an important handbook for all persons concerned with chemical pumping, but it will also prove instructive to those whose interests relate exclusively to the pumping of water.

The part of the book relating to fluid friction is highly technical; that relating to pumping equipment is mainly descriptive. The author's style is lighter and more readable than that of many other technical writers. Paper, printing and illustrations are of the best, and the book is accompanied by an adequate index.

Air Transportation

AN INTRODUCTION TO THE ECONOMICS OF AIR TRANSPORTATION—By Thomas Hart Kennedy. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 154; 9 halftone plates, 5 maps $2.

With the increasing importance of commercial flying, this review of what has been undertaken in the application of airplanes to such uses is not without value. The author has collected from scattered sources some data concerning the early attempts to use both lighter-than-air and heavier-than-air crafts for flying and has presented them, along with brief notes on attempts to maintain a regular service by private companies in this country, notes on commercial flying in Europe, and data concerning the U. S. Air Mail, in a very readable form. But outside of the interest which attaches to these data the book falls short of giving much that is necessary

in any study of the economic side of air transportation. Some definite figures on the cost of operating the U. S. Air Mail are given but there is a notable absence of such figures for purely commercial air routes. Possibly such figures are unobtainable, but as many of the European routes receive a government subsidy it is hardly conceivable. The book also lacks in timeliness. It gives the reader no definite information as to whether the commercial routes in this country, such as the routes between Florida and Cuba, are still in operation. The data given are for the year 1922 and the wording gives the impression that these are no longer operated. No figures for 1923 are given.

House Plumbing Studies

REVIEWED BY THE LATE GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

This review was transmitted to "Engineering News-Record" in a letter dated Nov. 20, or just a week before the sudden death of Professor Whipple. It may have been his last writing for publication.—EDITOR.

TESTS ON THE HYDRAULICS AND PNEUMATICS OF HOUSE PLUMBING—By Harold E. Babbitt, Associate Professor of Municipal and Sanitary Engineering, University of Illinois. [University of Illinois Engineering Experiment Station Bulletin No. 143.] Urbana, Ill.: University of Illinois. Paper; 6 x 9 in.; pp. 80; 31 line drawings and charts. 40c.

The experiments here reported were made upon full-sized plumbing installations. The conclusions reached are for the most part in line with those of the Sub-Committee on Plumbing of the United States Department of Commerce and reinforce the opinion that a 3-in. stack is large enough for an ordinary three-story residence and that there are advantages in omitting the main house trap. A formula is developed to show the relation between the pressure in soil stacks and the quantity of water discharged. Among the conclusions are the following:

The resistance of a trap to the passage of air through it varies directly with the depth of seal.

With unvented traps the pressure in soil stacks varies as the 5/2 power of the rate of discharge, i.e., $P = KQ^{5/2}$.

With vented traps the pressure, P, varies as some constant power of the rate of discharge, i.e., $P = KQ^m$, the value of m depending upon the type and capacity of the vent, being about 0.3 for very complete venting and 0.4 for no vent.

The rate at which the horizontal waste pipe of the same diameter as the soil stack will discharge water into a soil stack through a sanitary T without backing up in the waste pipe during a period of seven seconds may be taken to be as follows: 2-in. soil stack, 25 g.p.m.; 3-in., 50 g.p.m.; 4-in., 100 gallons per minute.

The closure of the top of the soil stack or the closure of vent pipes will result in such increases in pressure as to endanger the seals in traps. Soil stacks and vent pipes should, therefore, be designed to prevent the possibility of becoming stopped up.

The length of a 4-in. connection between a trap and the soil stack does not affect the pressure on the trap caused by water falling down the soil stack for traps not more than 25 ft. from the soil stack.

It is reasonably safe to use unvented traps, of any style, with a 2-in. depth of seal in one-story or two-story residences containing a single bath room and the normal number of kitchen and laundry fixtures connected to one 3-in. soil stack if proper precautions are taken.

F. W. Taylor and Scientific Management

FREDERICK W. TAYLOR: Father of Scientific Management—By Frank Barkley Copley. Two Volumes. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 467 and 472; halftone portraits and other illustrations. $10.

Biographies of engineers are so few as to make welcome any worthy addition to the number and doubly welcome one which for subject and treatment is so notable as the life and work of Frederick W. Taylor. The fact that Taylor and his part in the development of "scientific management" have been the subject of much controversy adds to the interest of this biography; all the more so because the author devotes much space and skill to the controversial aspects of Taylor's theories and practice.

That this is an authorized biography appears from the author's acknowledgment of sources put at his disposal and of "the support and counsel of a Committee consisting of Mrs. Taylor and Messrs. Sanford E. Thompson, Morris L. Cooke, and Edward W. Clark, 3d, with Dr. Harlow S. Person, managing director of the Taylor Society," co-operating. Besides what may be termed official assistance the author has counseled with many engineers and others who at some time in Taylor's career were in contact with him, including wage earners. The net result of the biographer's efforts is a comprehensive story of the aims, endeavors, achievements, defeats or only partial achievements of a man of unusual ability who devoted himself as few men have to the science of production and to his own conception of the welfare of industrial workers.

Ready for college but kept from it by ill health, Taylor began his life work in a Philadelphia machine shop. He speedily rose to be foreman and soon found himself in a position to begin what he made his mission in life: Finding and applying the laws controlling the one best way of doing a piece of work, whether finishing a locomotive tire or making a golf screen. He did not stop with the mere technique of the job immediately in hand. He went back of that until he had really taken in the whole shop or other industry and its management, including the accounting system, without which production costs could not be determined.

At the outset of his management career Taylor became convinced that the only way to get workmen to do a full day's work was to make it worth their while in terms of increased wages. He believed it to be the function of management to determine the best method of doing each part of a job, the best tool to use, the best way to sharpen it, etc., and the length of time to be allotted to each step in each man's task. To carry out such a scheme required much experimenting, then detailed planning and routing with instruction cards for each workman. All this took time and money. It upset old methods. It disturbed the foremen, superintendents and higher officials. It went against decades of practice and tradition among the wage earners. Small wonder that Taylor's successive engagements were relatively short, even after he entered consulting practice. In the earlier days, at least, he seems to have got on better with the wage earners than the management but later on, and that too after he had stopped working for money, he met the opposition of organized labor.

It should be understood that although Taylor went into a machine shop instead of to college, yet by night work he obtained a degree from Stevens Institute of Technology. His paper before the American Society of Mechanical Engineers on Piece Work, and his presiden-

tial address, some years later, on The Art of Cutting Metals, were each monumental contributions to engineering literature, the latter perhaps being unsurpassed as a record of technical advance laid before an engineering society by its president. In view of these great contributions to the society named, as well as his other work for it, it seems hard to account for the non-acceptance by a committee of the same society, later on, of Taylor's exposition of Scientific Management—hard on any other grounds than that attributed by his biographer, that it was due to timidity and professional jealousy. Fortunately the paper found a commercial publisher; but the Proceedings of the society were not crowned with the final number of Taylor's trilogy.

Altogether this biography is a notable piece of work. It contains as much frankly adverse criticism of Taylor as could be expected in an official biography. Without overmuch apology, the author accounts for Taylor's defects or partial failures in a way designed to show that, so far as they were personal, they were chiefly due to some of those human limitations which may get the better of the strongest character—in Taylor's case lack of tact and failure to put himself in the other man's place.

What seems to be the weakest part of the author's apologia comes in his repeated attempts to meet the accusations that Taylor's attitude toward wage earners was that of a rather inhuman task-master. Again and again the author makes statements, often in Taylor's own words, designed to show that Taylor, once a journeyman machinist himself, understood and sympathized with workmen. This he unquestionably did to a remarkable degree, but while Taylor was no mercenary taskmaster the testimony of this book is that his whole heart and soul were so imbued with production—whether of locomotive tires or of educational results from colleges—that he failed to recognize many other considerations that enter into life, and particularly the desire of labor to attain its ideal of emancipation and a share in the control of industry.

If the author's exposition of what for immediate purposes may be called the "Taylor system" does justice to Taylor, then that system has production as its object and remuneration at a pre-established rate as its reward, at a rate in the determination of which the worker has scarcely any part as an individual and absolutely none as a member of the wage-earning group. Nor is there a hint, in this biography, that Taylor was in the slightest degree concerned—although very likely he was—in any of the many efforts to improve the lot of the wage earner, beyond the single one of giving him a rate of pay commensurate with his output, under a plan devised entirely by others. How a just wage is to be determined or a fair division of earnings of an industry made between capital, management, and wage earners, the book does not make clear.

When all is said, most unbiased engineers who will carefully study Taylor's aims and efforts will agree that he worked on sound engineering lines—first determining his problem and the laws governing its solution, then planning out methods accordingly, then executing them, all the while trying to give every co-worker a just reward for his effort. What he seems to have lacked is a full recognition of all the elements in the human equation—many of which are quite beyond a solution by the most elaborate of the slide rules for the control of shop work devised by Taylor or his associates. This he seems to have overlooked quite as often as regards men in the control of industry as in the case of those in the lower ranks. That he was a man with a vision and a mission no impartial reader of this admirable biography will deny.

On Business Writing

BUSINESS WRITING: Articles, House Organs, Reports, Advertisements; Methods of Gathering Data and of Writing Business Copy of News, Educational, and Promotional Character—By S. Rowland Hall, Advertising Counselor; Formerly Advertising Manager, Alpha Portland Cement Co. and Victor Talking Machine Co.; Formerly Director of International Correspondence Schools of Advertising and Salesmanship; Author of "The Advertising Handbook," "The Handbook of Business Correspondence," "The Handbook of Sales Management," and "Retail Advertising and Selling." New York and London: McGraw-Hill Book Co., Inc. Fabrikoid; 5x8 in.; pp. 222; $2.50.

Mr. Hall has succeeded rather well in a broad and somewhat difficult undertaking. To be sure, it has not been practicable to discuss within the limits of so handy a book the fundamentals of writing in general, but, as he explains in his Preface, he has assumed his readers to have a working knowledge of composition and rhetoric.

Engineers generally will not be especially interested in the chapters on newspaper items, house organs or advertisement-writing, but they will find something of interest and value in the sections on writing articles for business magazines—including technical journals—and on the preparation of reports. Although most of the latter is devoted to reports remote from the interest of the engineer, the principles laid down are of general application. It is a pleasure to note in passing that the author has cited as an example of good planning and outline the report by the late Clifford M. Holland on the project for the Hudson River vehicular tunnel which now bears his name.

While by no means an engineering book "Business Writing" is worth the perusal of any engineer who would like some "brass-tacks" counsel on a subject that always offers possibilities of development into a professional asset.

PUBLICATIONS RECEIVED

CROSS-CONNECTIONS are prohibited in the Rules and Regulations Governing Service Pipe Installation, Chicago Water-Works, just issued under the joint authorship of A. A. Sprague, commissioner of public works, John Ericson, city engineer, and H. L. Lucas, superintendent water pipe extension. Diagrams showing how service pipes are connected up under various conditions are included.

SANITATION IN MINES has been published as Miner's Circular 28, by the U. S. Bureau of Mines (Washington, D. C.; one copy free).

AN ILLUSTRATED BULLETIN on Thawing Frozen Water Pipes with Electric Current has been brought out by the Engineering Extension Service of Purdue University (Lafayette, Ind.). The authors are D. D. Ewing, professor of electric railway engineering, and C. F. Bowman, assistant in electrical engineering.

THE LOGGING AND SAWMILL SAFETY CODE, prepared under the direction of the U. S. Bureau of Standards, deals with safety precautions to be observed in the felling of timber, transportation of logs by means of skidders and yarders, on ice and snow roads, and on chutes; logging railroads, river driving and rafting. The second of three parts into which the code is divided concerns itself with sawmill operations, including log conveyors, head saws, live rolls, edgers, trimmers, slashers, hog mills, lath and shingle mills, transfer tables, and conveyors. The third part deals with yard and kiln operations. (40c. in paper, 50c. in cloth from Superintendent of Documents.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ENTROPIE DES WASSERDAMPFES IN ELEMENTARER ABLEITUNG—Von Fritz Burk. Leipzig: Otto Spamer. Paper; 5x8 in.; pp. 47; 11 line cuts, 4 tables. Paper, 2 marks, cloth, 2.6 marks, gold, in Germany.

ERDDRUCK AUF STÜTZMAUERN—Von Richard Petersen, ordentlichen Professor an der Technischen Hochschule, Danzig. Berlin: Julius Springer. Paper; 6x9 in.; pp. 84; 80 line drawings. Paper, 5.4 marks, cloth, 6.3 marks, gold, in Germany.

ESSENTIALS OF APPLIED CALCULUS: PRINCIPLES AND APPLICATIONS, DESIGNED FOR STUDENTS AND ENGINEERS—By Robert Gibbes Thomas, Engineer and Professor Emeritus of Mathematics and Engineering at The Citadel, The Military College of South Carolina. An Abridged and Revised Edition of "Applied Calculus," With Additional Exercises and Formulas. New York: D. Van Nostrand Co. Cloth; 6x8 in.; pp. 408; line drawings. $2.50.

FÜNFUNDZWANZIG JAHRE ZEPPELIN-LUFTSCHIFFBAU—Von Dr.-Ing. E. H. L. Durr, Direktor im Luftschiffbau Zeppelin G. M. B. H., Friedrichshafen. Berlin: V. D. T. Verlag. Cloth; 9x12 in.; pp. 83; 186 halftones and structural sketches, 1 plate.

Illustrations and typography are worthy of this interesting account of twenty-five years of zeppelin airship building, by the director of the concern that builds the zeppelins at Friedrichshafen.

GRUNDLAGEN ZUR BESTIMMUNG DER MITTLEREN QUERSCHNITTSGESCHWINDIGKEIT IN NATURLICHEN FLUSSLAUFEN—Von Ing. Viktor Kudielka, Oberbaurat. Leipzig und Wien: Franz Deuticke. Paper; 7x10 in.; pp. 23; 2 plates. $0.50 in Germany.

MOTEURS À COMBUSTION INTERNE—Par Paul Dumanois. Ingénieur en Chef du Génie Maritime. Préface de M. Painlevé. Paris: Libraire J.-B. Baillière et Fils. Paper; 6x9 in.; pp. 517; 196 line cuts and halftones. 60 francs in Paris.

THE MUNICIPAL YEAR BOOK OF THE UNITED KINGDOM FOR 1924—Founder and Director, Robert Donald; Editor, C. F. Bulpitt. London, England: The Municipal Journal. Cloth; 6x9 in.; pp. 694. 15s. in London.

Contains the usual and some new information given in this standard directory of the officials and activities of the municipalities of England, Wales, Scotland and Ireland—by separate places, as text, and for various activities, by tabular summaries, the latter including, among other things, water, gas, electric light, power and railways, sewage and refuse disposal, street cleaning.

POWER STUDIES IN ILLINOIS COAL MINING—By Arthur J. Hoskin, Research Associate Professor of Mining Engineering, and Thomas Fraser, Research Assistant Professor of Mining Engineering, both of University of Illinois Engineering Experiment Station. (Engineering Experiment Station Bulletin 144.) Prepared under a co-operative agreement between the Engineering Experiment Station of the University of Illinois, the Illinois State Geological Survey, and the U. S. Bureau of Mines. Urbana: University of Illinois. Paper; 6x9 in.; pp. 80. Free upon application.

DER PRAKTISCHE EISENHOCHBAU: II BAND, KRANLAUFGAHNEN—Von Alfred Gregor, Oberingenieur bei Breest & Co., Berlin. Berlin: Hermann Meusser. Cloth; 9x11 in.; pp. 187; many structural drawings, mathematical tables. 20 gold marks, in Germany.

PRINCIPLES OF RAILWAY TRANSPORTATION—By Eliot Jones, Ph.D., Professor of Economics in Stanford University; Author of "The Trust Problem in the United States," "The Anthracite Coal Combination in the United States." New York: The Macmillan Co. Cloth; 6x9 in.; pp. 607. $3.50.

STRAIGHT LINE ENGINEERING DIAGRAMS—By Manifold & Poole, Consulting Engineers, Los Angeles, Calif. Los Angeles: Manifold & Poole. Flexible; 8x5 in.; pp. 105; 52 drawings and explanations.

In handy form there are given 52 diagrams each with explanation, example and solution, the latter including directions. Among the subjects covered are bearing power of piles; strength of beams; masonry arches, concrete and "concrete steel" (5 drawings); electric circuits; power transmission lines; flow of water in (a) pipes (5 values of *n*) and (b) canals and flumes (6 drawings); shafting; waterwheels and water hammer.

STRUCTURAL ENGINEERING: Fundamental Properties of Materials—by George Fillmore Swain, LL.D., Gordon McKay Professor of Civil Engineering in Harvard University, Past President Am.Soc.C.E., M.Inst.C.E., etc. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 200; 49 line cuts. $2.50.

A STUDY OF THE POLLUTION AND NATURAL PURIFICATION OF THE OHIO RIVER: Report on Surveys and Laboratory Studies—Physiography, by J. K. Hoskins, Sanitary Engineer; Hydrometric Studies, by H. W. Streeter, Sanitary Engineer; Sources of Pollution, by R. E. Tarbett, Sanitary Engineer, W. H. Frost, Surgeon, and J. K. Hoskins, Sanitary Engineer; Plan and Methods of Laboratory Studies, by W. H. Frost, Surgeon; Chemical Studies, by H. W. Streeter, Sanitary Engineer, and W. H. Frost, Surgeon; and Bacteriological Studies, by W. H. Frost, Surgeon, and H. W. Streeter, Sanitary Engineer. Washington, D. C.: U. S. Public Health Service. Paper; 6x9 in.; pp. 343; 46 charts and plates. 60c. from Superintendent of Documents.

The range of the contents of this volume is indicated above. A brief abstract of the section on bacterial studies appeared in *Engineering News-Record*, Dec. 11, p. 962.

DIE VENTILATOREN: BERECHNUNG, ENTWURF UND ANWENDUNG—Von Dr. Sc. Techn. E. Wiesmann, Ingenieur. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 196; 135 line cuts and halftones. 10.5 marks, gold, in Germany.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Relative Foot-for-Foot Prices of Old and New Types of Cast-Iron Pipe

Sir—In your editorial note of Oct. 9, 1924, p. 573, entitled "Water Pipe Changes," you state "As to the newer cast-iron pipe, disappointment has been felt because there is as yet no clear indication that, foot for foot, it will be any cheaper than the older and heavier cast-iron pipe." From the wording it appears that you refer to deLavaud centrifugally cast cast-iron pipe and we believe that your readers will recognize our product from this description. The deLavaud pipe has always been sold about five per cent per foot cheaper than sand cast.

JOHN D. CAPRON,
Publicity Manager, U. S. Cast Iron Pipe and Foundry Co.

Burlington, N. J.,
Dec. 8, 1924.

[The reference applied to both types of spun cast-iron pipe, as the context showed.—EDITOR.]

Alumina Cement Concrete Will Adhere to Portland Cement Concrete

Sir—In Dr. Gustave Haegermann's article, "High Early Strength Portland Cements in Germany," presented to the Portland Cement Association as abstracted in *Engineering News-Record*, Dec. 4, 1924, p. 910, Dr. Haegermann stated that, "alcement should not be superimposed on concrete of portland cement, as it has been proved that disintegration takes place."

Available evidence does not support this conclusion of Dr. Haegermann. In fact it proves that a very satisfactory bond can be obtained between alumina cement and portland cement concretes.

First, Lumnite cement, an alumina cement, has been extensively and successfully used in repairing portland cement concrete roads and floors.

Second, a top-coat of Lumnite cement mortar applied to a portland cement concrete base bonded to the base without any subsequent indication of separation or failure. When the slab was later broken for examination, some of the portland cement concrete adhered to the Lumnite cement top-coat, indicating that not only the top-coat but the bond itself was stronger than the portland cement concrete base.

Third, the following tests made by Columbia University prove that Lumnite cement concrete will bond to portland cement concrete and that the bond has a high degree of strength.

Concrete test bars 4x4x18 in. were made with one-half of the bar-length of 1:2:4 Lumnite cement concrete, and one-half of 1:2:4 portland cement concrete. The portland cement halves of the bars were 56 days old and the Lumnite halves 28 days old when the composite bars were tested. Where the Lumnite cement concrete was bonded to a rough end of portland cement concrete, the test bars developed an average modulus of rupture of 397 lb. per square inch, the break occurring at the junction. Where the Lumnite cement concrete was bonded to the smooth end (scratched) of the portland cement concrete, the test bars developed an average modulus of rupture of 238 lb. per square inch, the break occurring at the junction. Test bars made entirely of portland cement concrete developed an average modulus of rupture of 456 lb. per square inch at 28 days. Test bars made entirely of Lumnite cement concrete developed an average modulus of rupture of 953 lb. per square inch at 28 days.

Fourth, the La Farge Co., manufacturers of an alumina cement in France, state in their literature that alumina cement concrete "adheres perfectly" to portland cement concrete.

In addition to the foregoing I have had the pleasure of meeting Dr. Haegermann and discussing this subject with him. It seems that this conclusion was not based on personal knowledge but upon an incident related to him by a French engineer to the effect that an alumina cement top-coat had separated (not disintegrated) from a portland cement concrete base.

The separation of a portland cement top-coat from a portland cement concrete base is not unknown. Such a failure is generally accepted as the result of improper preparation of the surface of the base before applying the top-coat.

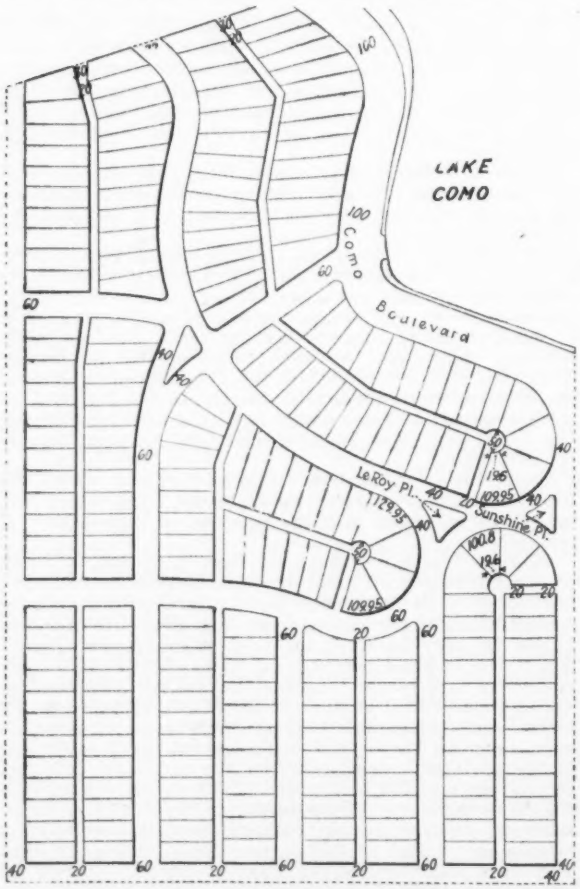
JOSHUA L. MINER.
Atlas Lumnite Cement Co.

New York City,
Dec. 12, 1924.

Street Intersections With Curved Layouts and Radial Lot Lines

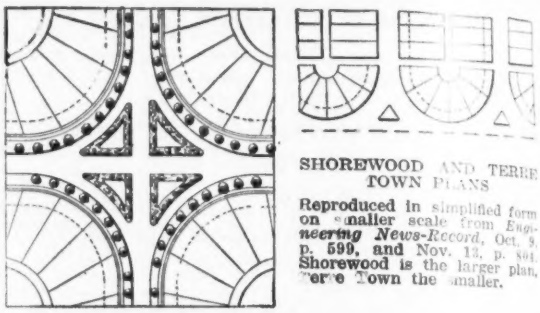
Sir—I have noted the street intersection and lot layout plan by H. A. Schmitt, village engineer of Shorewood, Wis., published in *Engineering News-Record*, Oct. 9, p. 599, and also W. R. Page's letter published in your issue of Nov. 13, p. 804, in which Mr. Page shows a curved street intersection designed by him. I enclose a blueprint of an addition in St. Paul known as "Warrendale" which utilizes the same principle, and which was recorded in the Register of Deeds book June 5, 1885, also a recent adaptation of this Warrendale street intersection in St. Paul located at St. Albans St. and Laurel Ave. I believe there are numerous examples showing that this idea has been used for years.

The four corner lots at St. Albans St. and Laurence Ave. were dedicated to the city for use as a public market years ago when the plot in which they are located was recorded.



WARRENDALE ADDITION, ST. PAUL, MINN.

Besides curved streets for a part of the area, note the three adjacent block ends with curved fronts, radial side lines for the lots and a nearly circular enlargement of the alleys at the rear of these lots. Note also the three parked islands at street intersections. This addition was recorded June 5, 1885.



SHOREWOOD AND TERRE TOWN PLANS

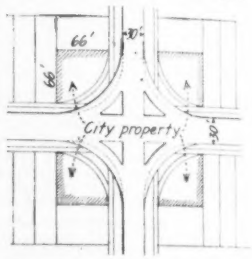
Reproduced in simplified form on smaller scale from *Engineering News-Record*, Oct. 9, p. 599, and Nov. 13, p. 804. Shorewood is the larger plan, Terre Town the smaller.

They are now in a nice residential district. We are advocating that corners be cut back 10 to 15 ft. and the use of a 26-ft. radius for curbs and are getting a number of such.

GEORGE H. HERROLD.

St. Paul, Nov. 18, 1924.

[Aside from the point raised by Mr. Herrold, the Warrendale Addition is an interesting variant from the rectangular plan so general in the eighteen eighties. A boulevard paralleling the curved lake front is the point of departure and leads naturally to other curved streets and to three blocks with semi-circular ends, subdivided by radial lot lines, and having also inner curved ends formed by cutting a circular area out of the interior of the block, with alleys leading from this interior court at right angles to each other. There are three "island" parked "places," two coming opposite the semi-circular-ended blocks and a third well placed in relation to intersections of more broadly sweeping curves.



RECENT ADAPTATION OF WARRENDALE PLAN AT ST. PAUL

Plan for intersection of St. Albans St. and Laurel Ave., dated Nov. 21, 1923.

The Shorewood and Terre Town layouts, mentioned by Mr. Herrold (reproduced here in simplified form) and three of the block ends shown in the Warrendale Addition are quite similar in their curved block fronts and their corresponding alleys.

The parked islands in the Warrendale Additions and at Terre Town occupy the portions of the street intersections that are unused—as was made evident by the raveled surfaces in the old waterbound macadam days. At Warrendale, owing to the compound curves and the 60-ft. widths of two of the streets, these parked islands have considerable size and corresponding dignity. The parked islands at Terre Town look shrunken in comparison, owing partly to their approximately triangular shape. At Shorewood and at the St. Paul street intersection shown herewith, where in each case traffic facilitation and safety are the main objects, there are four parked islands instead of one. These give something of a mass effect, particularly when seen from the curved portions of the sidewalks and the lawns—assuming there are lawns—and lower portions of the houses back of them. At St. Paul the four parked islands have the already small area available for greenery on each still further reduced by carrying the sidewalks across each. At Shorewood this is avoided, apparently on the assumption that pedestrians will cross back of the curve, where the crossing is the narrowest. At St. Paul, although island crossings enable the pedestrian to deal separately with vehicles making the turns and those passing straight through, there are two steps down and as many up and more than double the distance to walk across the street pavement than at Shorewood.

Finally, the Warrendale Addition, dated 1885, was designed long before the days of automobiles and for a residential district of ample but (except for the boulevard) moderate street widths. The other examples also seem to be designed for residential districts, but with automobile traffic in mind. Lot subdivision outside the ordinary rectangular practice also enters more or less into all the plans except the St. Paul plan of 1923.—EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Bascule Bridge Suit Heard in Chicago

Features Involved in Infringement Charge Against City Ruled As Not Patentable

Certain features in the design of a double-deck bascule bridge, applicable to both rolling-lift and trunnion types, do not constitute a patentable invention but are "merely the exercise of the skill of the competent engineer" is the decision rendered by Judge Lindley, of the U. S. District Court at Chicago, in a suit brought against the city of Chicago by the Scherzer Rolling-Lift Bascule Bridge Co. This suit alleged infringement of a patent on double-deck bascule bridges in the city's construction of the Michigan Ave. bridge in 1920, since which time the patent has expired. The features in question related to the relative positions of the two decks in plane of the truss chords, the location of the trunnions so as not to interfere with the lower deck, and the use of a short arm with upper deck shorter than the lower deck in order to clear the approach structure. A summary of these features, condensed from the court's decision, is as follows:

"Double-deck bridges of other types are old in the art and known to the profession. The truss described in the patent and embraced in the defendant's structure is also old. In the plaintiff's patent all these old practices are combined in the double-deck bascule bridge and unless this combination results in something novel, representing more than mechanical skill in aggregation, or unless there is some new element involved and included in the claims constituting patentable invention, the patent cannot stand.

The only other elements which plaintiff claims as a part of its invention are: (1) The position of the two decks, placed approximately in the planes of the upper and lower chords; (2) the location of the trunnion in such position as not to interfere with traffic in the lower deck; (3) the construction of the projecting arms of the shore end of the bridge, the upper being shorter than the lower, thus permitting the two arms to descend in an arc without interfering with the projections from the approach. It seems apparent that one who has constructed single-deck bascule bridges, confronted with the necessity of such a bridge with two floors, would easily and naturally adopt the prior art, and with the ordinary mechanical skill of a bridge builder extend the principles to the double-deck bridge."

The court supported its decision by reference to Prof. Burr's proposed design for a memorial bridge across the Potomac in 1900 and the double-deck bascule bridge designed by the engineers of the city of Chicago in 1901. While the court held that the "patent is void for want of patentable invention," it pointed out also that if the patent had been valid the features which it covered had not been anticipated, as claimed by the city, and that all other contentions on behalf of the city, as defendant, "would of necessity be denied."

American Falls Dam Bids To Be Opened Jan. 22

Sealed proposals will be received at the office of the Bureau of Reclamation, American Falls, Idaho, until 2 o'clock p.m., Jan. 22, 1925, for the construction of the American Falls Dam.

The principal items involved are about 50,000 cu. yd. of earth excavation, 60,000 cu.yd. of earth embankment, 28,000 cu.yd. of rock excavation, 115,000 cu.yd. of concrete, together with the placing of approximately 1,100,000 lb. of reinforcing steel, 1,200,000 lb. of structural steel, and 1,700,000 lb. of cast-iron gates.

Highway Safety Conference Held

Approximately 500 individuals and representatives of organizations interested in highway traffic safety and means to insure it attended the National Conference on Street and Highway Safety held under the auspices of the Department of Commerce in Washington Dec. 15 and 16. Owing to the well ordered plan of a steering committee the eight committee reports, which had been prepared after months of investigation, were read and fully discussed during the four sessions of the conference, and the main recommendations of all reports were embodied in a general report as to future operation along traffic safety lines. President Coolidge addressed the conference and Secretary of Commerce Hoover presided.

An editorial review of the conference's deliberations will be contained in the issue of Dec. 25.

Welland Canal Contract Let

The Canadian Government has awarded the contract for the construction of Section No. 7 of the Welland Canal to the Canadian Dredging Co., which company has just completed Section No. 5. The new section extends from Port Colburne to Welland, taking in the Rainey Bend, which will be removed.

The work will involve the removal of approximately 10,000,000 cu.yd. of earth and 1,500,000 yd. of rock and the placing of a large amount of concrete. Five new bridges are to be built. The work will last for about five years.

Road Builders Announce Convention Program

Score of Addresses and Technical Papers Scheduled for Meeting in Chicago Jan. 6-8

The program for the annual convention of the American Road Builders' Association to be held in Chicago, Jan. 6-8 has just been announced by Prof. T. R. Agg, chairman of the program committee. All sessions of the convention will be held in the Elizabethan Room of the Congress Hotel. The program convention follows:

January 6

Morning Session at 10:30 a.m., President Cranford presiding.

1. Opening address by President Cranford.
2. "Building a System of National Roads Through Federal Aid," Thomas H. MacDonald, Chief of Bureau of Public Roads.

Afternoon Session, at 2.30 p.m., George W. Tillson presiding.

3. "Impressions of English Highway Practice," Austin B. Fletcher, consulting engineer, Bureau of Public Roads.
4. "Are State Highway Programs on a Sound Financial Basis?" H. R. Trumbower, economist, Bureau of Public Roads.
5. "Legal Aspects of Trunk-Line Roads Through Cities and Villages," Samuel K. Markman, Chicago, Ill.
6. "Suggested Revisions in Brick Paving Practice," W. D. P. Warren, consulting engineer, Decatur, Ill.

January 7

Morning session at 9.30 a.m., Paul D. Sargent, presiding.

7. "Relation of Traffic Surveys to Highway Programs," William H. Connell, engineering executive and deputy secretary of highways, state of Pennsylvania.
8. "The Evolution of Highway Traffic," Arthur H. Blanchard, professor of highway engineering and highway transport, University of Michigan.
9. "The Super-Highway Plans of Wayne County, Michigan," Edward N. Hines, chairman, Wayne County Board of Highway Commissioners.

Afternoon session at 2.30 p.m., Frank Page presiding.

10. "Planning a Greater Chicago," E. S. Taylor, Manager, Chicago Plan Commission.
11. "Problems of State-Wide Highway Maintenance," Frank T. Sheets, chief highway engineer, Illinois Division of Highways.
12. "Utilizing the Salvage Value of Old Roadway Surfaces," A. H. Hinkle, maintenance engineer, Indiana Highway Department.

Election of Officers.

January 8

Morning session at 9.30 a.m., T. J. Wasser presiding.

13. "Determination of Stability of Asphalt Paving Mixtures," Prevost Hubbard, chemical engineer, The Asphalt Association, New York.
14. "The Contribution of Research to Highway Progress," Frank Page, chairman of North Carolina Highway Commission.
15. "Dust Elimination on Gravel Roads," B. C. Tiney, maintenance engineer, Michigan Highway Department.
16. "The Final Link in the Lincoln Highway in New Jersey," Harry D. Robbins, division engineer, New Jersey Highway Department.

Afternoon session at 2.30 p.m., A. H. Blanchard presiding.

17. "Form Setting and its Relation to Riding Qualities of Concrete Pavements," C. N. Conner, state construction engineer, Raleigh, North Carolina.
18. "Investigations of Smoothness of Pavements," H. F. Clemmer, engineer of tests, Illinois Division of Highways.
19. "The Evolution of Construction and Maintenance Equipment," O. L. Kipp, construction engineer, Minnesota Highway Department.

Supreme Court Hears Lakes Diversion Case Argument

Indications Are Injunction Against Chicago Sanitary District Will Be Upheld

Washington Correspondence

Arguments in the appeal of the Chicago Sanitary District from a decision of the Federal district court granting the United States an injunction against the diversion of water amounting to 10,000 sec.-ft. from Lake Michigan when only 4,167 sec.-ft. were authorized in the permit issued by the Secretary of War under authority of Congress, were presented before the U. S. Supreme Court Dec. 8 and 9.

Members of the court evidenced keen interest in the issues presented and counsel were interrupted by frequent questions from the bench. From the tenor of these questions, the indications are that the Supreme Court will sustain the injunction, about the only point which appears in doubt being the time which will be granted the Chicago district to make other arrangements for disposal of its sewage before the injunction shall be made fully operative.

That the health of a great community is involved in this case was stressed by counsel for the sanitary district and mentioned by other attorneys in the case also. It was contended for the sanitary district that in 21 years Chicago will have a new system of sewage disposal completed, and not be so dependent upon water from the Great Lakes system. Counsel for the government did not admit that 10,000 sec.-ft. from Lake Michigan is necessary to carry Chicago's sewage down the canal and thence toward the Gulf of Mexico, contending, on the contrary, that the excessive withdrawal of water from the lake is due to a power scheme rather than to purely sanitary needs.

The Court displayed much interest in whether the present rate of diversion actually is lowering the level of Lake Michigan, and interfering with navigation. This was denied by counsel for the sanitary district, but affirmed by counsel for opposing interests.

E. D. Adcock, attorney for the sanitary district, admitted that the permit issued in 1901 calls for only 4,167 sec.-ft diversion but said that the interest of the Secretary of War at that time was primarily in preserving navigation in the Chicago River; that since that time, this river has been straightened so that heavier diversion does not hamper its navigability; and that withdrawal of only 4,167 sec.-ft. would cause the river, at certain seasons, to reverse its current and flow into Lake Michigan, as it did before changed artificially. Daniel L. Kirby, of St. Louis, representing several Mississippi Valley states, spoke in behalf of the sanitary district, the valley states being interested in a water-ways project from Chicago to the Gulf.

Solicitor-General James M. Beck made the principal argument for the government. He characterized the excessive diversion as a flagrant defiance of the federal government. The case has been dragging 16 weary years, he said, criticizing former District Judge K. M. Landis, now the high commissioner of baseball, before whom testimony was taken six years, Judge Landis then holding the case six more years and, finally deciding for the government, failing to enter his decree for two years further, until he resigned from the bench, thus delaying an appeal. Chicago, in the meanwhile, should have taken steps for sewage disposal by other means, he insisted, adding that excessive diversion is more for power projects than for the carriage of sewage.

Andrew B. Dougherty, attorney-general of Michigan, argued in behalf of that state and of Indiana, New York, Ohio, Pennsylvania, Wisconsin and Minnesota, which intervened in the case in opposition to excessive diversion. He stressed the importance of the issue to Great Lakes shipping, saying commerce on the lakes has increased 4,000 per cent since this suit was started. The three greatest rivers flowing into Lake Michigan supply 11,000 sec.-ft. of water, and the Chicago sanitary district withdraws 10,000 sec.-ft. he said. He declared Chicago has no right to take water in quantities interfering with commerce on the lakes and affecting the interests of other states and cities.

Harvey D. Goulder, attorney for the Great Lakes Carriers' Association, told the court that the excessive diversion has seriously affected navigation. The capacity of 22-ft. vessels was seriously affected by the diversion of even the 4,167 sec.-ft. authorized in the permit, he said. Congress has spent $100,000,000 on Great Lakes harbors, Mr. Goulder said, and these will have to be further dredged. Tonnage on the Great Lakes is equal to 45 per cent of the traffic of the American ports on the Atlantic, Pacific and Gulf combined, he said.

Inasmuch as the Supreme Court has a voluminous record and many briefs to examine in the Chicago diversion case, an early decision is not expected.

Most of Charges Against Hydro Commission Found Untrue

The report of Judge Colin G. Snider, the commissioner appointed to investigate charges of irregularities brought against the Ontario Hydro-Electric Power Commission by E. C. Seltell, formerly secretary to Sir Adam Beck, has been published. Out of 85 charges made by Seltell, the report finds that 66 are false, and the remaining 19 true, or partly true. All the most important charges affecting the integrity of Sir Adam Beck are found to be untrue. J. B. Lucas, solicitor for the Hydro Electric Power Commission, is found to have employed three members of his family in the Hydro service at substantial salaries, constituting a case of "censurable nepotism," and F. A. Gaby, chief engineer, was found guilty of a "reprehensible and improper" transaction in selling to the commission for $4,400 a steam shovel which was his own property.

Seltell, who made the charges, was recently sentenced to three years' imprisonment for the attempted theft of $29,000.

Mountain Division Work on Hetch Hetchy Stopped

City Hall Furor Causes Temporary Suspension of Tunnel Lining and Aqueduct Crossing

As a result of the furor in the San Francisco City Hall about Hetch Hetchy construction, reported in *Engineering News-Record*, Dec. 4, p. 926, work was stopped in several mountain camps on Dec. 8, and 500 men were laid off. In response to the injunction suit previously referred to, the court ruled that the acting mayor's stop order was not binding on the board of public works. The latter body, however, had already passed a resolution pursuant to the acting mayor's order and on the auditor's showing that money remaining in the 1910 bond issue fund was insufficient for further work, the resolution was allowed to stand even though it discontinued all tunnel lining and the construction of the South Fork aqueduct crossing—two operations which were considered highly important.

Another development in this situation was that the board of supervisors modified the 1913 ordinance which gave the board of public works, and through that body the city engineer, authority to let contracts, purchase supplies and, in general, to operate without restriction in carrying on the work. Under the modified ordinance the board of public works must henceforth itemize its budget and get the approval of the supervisors in advance.

The supervisors have been endeavoring to find some financial plan whereby the depleted 1910 bond fund can be supplied with funds to complete the work. The city attorney reports that the charter prohibits borrowing money direct from the banks. Several proposals for meeting the present needs were made: (1) The Construction Company of North America, which holds extensive Hetch Hetchy contracts, offered to finance the remaining work in the mountain division if the city would agree to pay 5 per cent on money advanced; (2) it was suggested that a 5-year contract for the wholesaling of Hetch Hetchy power to the Pacific Gas & Electric Co. should be made under terms whereby the city would receive one million dollars now as an advance payment for the power to be delivered later; (3) it was proposed that the Spring Valley Water Co., which is to pay the city $250,000 annually as interest on the construction cost of the bay crossing so long as this should be used to bring in Calaveras water, be asked to make an advance payment of four years' interest.

Meantime, the Construction Company of North America guaranteed the board bill of the 500 men laid off and urged them not to disband, at least for several days, pending the development of some financial plan acceptable to all factions.

A report received just as this issue goes to press states that the Spring Valley Water Co. has agreed to the advance interest payment plan; it was expected that this plan would be consummated and that work would be resumed within a few days.

Added Reclamation Responsibility Vested in R. F. Walter

Secretary Work's latest order, published elsewhere in this issue, concentrates much additional responsibility in the hands of the chief engineer of the Reclamation Bureau. Since the resignation of F. E. Weymouth, Raymond F. Walter has been serving as acting chief engineer. All indications are that Mr. Walter will continue in immediate charge of the Bureau's engineering activities for an indefinite period.

Mr. Walter is a native of Illinois. His higher education was obtained at the Colorado Argicultural College. Immediately on graduating from that institution he was elected county surveyor for Weld County, Colorado, a position which he held for four years. For three years thereafter he served as the city engineer of Greeley and then for another three years was assistant state engineer for Colorado.

Mr. Walter entered the Reclamation Service on May 20, 1903. For more than six years he was in charge of construction and operation on the Belle Fourche project in South Dakota. His record there resulted in his selection for the position of supervising engineer in charge of the central division of the Bureau. He continued in that work for six years, when he was assigned to the Rio Grande project as senior engineer and project manager of the southern division. On June 8, 1916, he was made assistant chief of construction and senior engineer at the Denver office of the Bureau. He was appointed assistant chief engineer on May 1, 1920, a position he held until March 16, of this year, when his title was changed to that of drainage engineer. He has been acting as chief engineer since Nov. 1.

Contract for Section A of River Des Peres Sewer Relet

The Board of Public Service of St. Louis, Mo., has arranged with J. J. Dunnegan, a contractor of Shenandoah, Iowa, to complete the construction of Section A of the River Des Peres storm sewer on a cost-plus basis, the amount to be paid by the city not to exceed $363,000. This contractor was the next to the lowest bidder when bids were received, having bid $408,629. The contract was awarded to the lowest bidder, the Higgin-Wall-Dyer Construction Co., of St. Louis, for $324,452, or $84,000 below the Dunnegan bid and $20,000 below the city's estimate for the work. When the first contractor had built 750 ft. of the sewer, during which construction period high water and other difficulties were encountered, and Harold Dyer, a member of the company had been drowned, the city took steps to cancel the contract on the ground of unsatisfactory progress. About $62,000 had been paid at the time, according to the records of the city.

Plan for Aided Reclamation Settlement Proposed

Senator Kendrick Introduces Bill Into Congress—100-Farm Divisions Are to Benefit

Washington Correspondence

A bill providing for "aided and directed settlement on government land in federal irrigation projects" has been introduced by Senator Kendrick of Wyoming. Immediately after the bill appeared in printed form, Senator Kendrick's attention was called to certain imperfections in his bill and he has accepted alterations which will be made in committee. As perfected the measure provides that in connection with the development of any federal irrigation project the Secretary of the Interior may designate as a division of the project an area of irrigable land owned entirely by the United States and large enough to create at least 100 farms, and at least five farm laborers' allotments, to which the aided and directed settlement is to be applied.

When the unentered public land in a project is insufficient in area or unsuited for such a division, the secretary is authorized to acquire by gift, or by purchase at an average price not to exceed $10 per acre needed land to make one such division. The secretary is directed to classify the land according to character of soil, character of surface and distance to markets. It then is to be sub-divided and appraised as to productive value under irrigation, exclusive of construction charges and water rights, in order to make them equally attractive to settlers.

The farms are to be offered for sale at the appraised values. Payment is to be made in semi-annual amortized installments over a period of 40 years. Five per cent is to be paid per annum, including interest which is to be at the rate of 4 per cent. Any part or all of the remaining indebtedness may be paid on any payment date. The construction charges and operation and maintenance charges are to be paid in accordance with the reclamation law.

Each applicant for a farm must show that he has had at least one year's actual farm experience and sufficient capital in money or farm equipment to equal one-fourth of the appraised value of the farm. Actual residence on the farm for at least eight months in any calendar year is required. The secretary is authorized to grant leave of absence to take care of emergencies. No sale or lease can be made without the approval of the secretary. Patent is to be issued upon payment in full of the purchase. Purchase contracts are to provide for payment by settlers of local and state taxes and irrigation district assessments.

The secretary is authorized to advance for permanent improvements and for livestock, an amount not exceeding $3,000 for any one farm, and not exceeding $800 for any one laborer's allotment. This advance must not exceed 60 per cent of the value of the improvements or livestock for which the advance is made. The settler must have the remaining 40 per cent in hand before the advance is made. Such advances are to constitute a first lien on the improvements and are to be paid, with interest at 4 per cent, in semi-annual installments amortized over a period not to exceed 20 years. Advances for livestock also must constitute a first lien and must be paid with interest at 4 per cent, in monthly installments amortized over a period not to exceed 3 years. The Commissioner of Reclamation is to adopt such safeguards as may be necessary to insure the use of the entire advance for the purpose for which it was made.

Field Control of Reclamation Again Under Chief Engineer

An order just issued by the Secretary of the Interior, effective Jan. 1, unifies field control of reclamation matters in the hands of the chief engineer. The Denver office will be under the sole direction of the chief engineer, and the division of authority there, which did not work out successfully, will be done away with. The order provides the following:

The chief engineer is to have charge of all matters relating to the engineering investigations, construction, operation and maintenance of the project, and of all employees of the Denver office, except the director of reclamation economics and his force and the legal staff. The director of reclamation economics, who also is located at Denver, has charge of the investigation of economic problems connected with the development of existing or proposed reclamation projects, including the classification and settlement of land and the improvement of the industrial, agricultural and social conditions of the settlers. On each project, the project superintendent is in charge of all employees except the district counsel and his force, and of all work connected with the construction and operation of the project, including the execution of contracts; the superintendent reports to the chief engineer.

The position of office manager at Denver is abolished, and the title of the incumbent is changed to chief clerk, reporting to the chief engineer.

Contract Work on Reclamation Projects Discussed

The Secretary of the Interior has made the following statement in regard to the performance of work on reclamation projects:

"There is a class of work in reclamation such as the cleaning of canals, the enlargement of canals and operation which involves interruptions and the conduct of work under peculiar conditions that can be done best by force account. This has been so well demonstrated that contractors admit it, but it is our purpose at all times, when conditions are such that we can make definite specifications, to give contractors an opportunity to show what they can do. This policy of the Department has been explained fully to contractors' organizations, and has been accepted by them as being entirely satisfactory, and has been so stated in their publications."

St. Lawrence Joint Engineering Board Ends Session

Nothing transpired at the recent meeting in Washington of the international engineering board, which is considering the development of the St. Lawrence, to justify newspaper articles stating that the meeting was a "victory for the Canadian viewpoint." The truth of the matter is that the meeting simply was a discussion of the engineering phases of the problem. No questions were involved that presented an opportunity for either the Canadian or the American engineers to attempt to secure an advantage. No formal action of any kind was taken. In fact, an official Canadian statement was issued—by George B. Graham the head of the Canadian Commission—pointing out that there is no basis in fact for some of the newspaper articles.

The engineers gave out no public statement as to their meetings because there were no developments of a news character. They simply continued their discussion of the most effective way of securing the needed additional engineering data.

Since the American engineers are recommending that legislative authority be secured to allot $275,000 of river and harbor money for borings at St. Lawrence damsites, it is assumed that one of the decisions of the meeting was that more borings should be undertaken as was planned originally.

The full membership of the engineering body was in attendance as follows: Canadians—D. W. McLachlan, Bureau of Railways and Canals; O. O. Lefebvre, chief engineer of the Quebec Streams Commission; Gen. C. H. Mitchell, dean of engineering, University of Toronto; Americans—Gen. Edgar Jadwin, assistant chief of engineers, U. S. Army; Col. William Kelly, chief engineer, Federal Power Commission, and Col. G. B. Pillsbury, Corps of Engineers.

Bill Fixing Mead's Salary at $11,000 Favorably Reported

A salary of $11,000 per year is provided for the Commissioner of Reclamation in a bill reported favorably by the Senate Committee on Irrigation and Reclamation. Under the reclassification which will become effective July 1, 1924, the salary of this position will be limited to $7,500 per annum.

Doctor Mead had been receiving a salary of $11,000 per annum from the University and State of California. He was reluctant to sacrifice that position to become commissioner of reclamation, but Dr. Work persuaded him to accept, with the hope that Congress would increase the salary to an amount equal to that which he has been receiving.

New Orleans Bridge Project

The latest step for the proposed Mississippi River bridge at New Orleans is that the New Orleans Public Belt Railroad Commission has applied to the War Department for a permit to build a combined highway and railway bridge estimated to cost $12,000,000. The commission has retained Ralph Modjeski as its engineer.

U. S. Orders Cement Securities Co. of Denver Dissolved

Attorney General Stone has announced receipt of advices from Denver, Colo., that U. S. District Judge T. Blake Kennedy, of the District of Wyoming, holding court at Denver, had entered a dissolution decree in the civil suit instituted by the government in January, 1922, against the Cement Securities Co. and several companies owned and controlled by it. A combination in restraint of trade in portland cement throughout the Rocky Mountain states was found to violate the Sherman anti-trust law.

The decree which was entered after arguments on the petition and answer, ordered the dissolution of the combination into such separate and distinct parts as will bring about "competitive conditions and a situation in harmony with the law." The defendants will also be enjoined from hereafter agreeing with other manufacturers of cement to engage in a number of so-called "trade practices" which the government insists materially facilitated the accomplishment of the objects of the combination.

The Cement Securities Co. owned or controlled the Colorado Portland Cement Co. and the U. S. Portland Cement Co., operating cement mills at Portland and Concrete, respectively, in the state of Colorado; the Three Forks Portland Cement Co., operating mills at Trident and Honover in Montana; the Union Portland Cement Co., operating a mill at Devil's Slide, Utah; the Nebraska Cement Co., operating a cement mill at Superior, Nebraska; and the Oakland Portland Cement Co., operating a mill at Ada, Oklahoma.

The decree provides that certain of the plants controlled by the Cement Securities Company must be disposed of and that the sales contract with the Utah Sales Co. shall be abandoned. In its dissolution order the Court says: "It is believed that when the provisions of this decree shall be carried out, it will bring about a competitive condition in the cement industry in the so-called Rocky Mountain Region."

Bill Allowing Federal-Aid Road Funds on Senate Calendar

The Senate Committee on Post Offices and Post Roads has reported favorably the bill carrying the authorization for the funds for federal-aid highways during the next two fiscal years. The bill now is on the Senate calendar and will be considered in the near future.

The bill authorizes the appropriation of $75,000,000 for each of the fiscal years. It also authorizes $7,500,000 for each of the two fiscal years for forest roads and trails.

In recommending that the Senate pass the measure the committee points out that the principle of federal aid for road construction is an established policy of the government. Attention is called to the fact that the authorization must be forthcoming promptly so that the states may make the necessary surveys and submit their plans and specifications for approval.

Random Lines

Beyond the Joke Stage

This adjectival engineer stuff is getting pretty bad when so careful a paper as the New York *Times* in a serious front page story of a hold-up in a shop where they make these waxen images that strut and pose as clothes hangers in department store windows included the following sentence: "Schol-wook dropped the hand with the ring and it was snatched off; it cost $2,800 the beauty engineer told the police afterwards."

* * *

Student: "What is a consulting engineer?"

Professor: "A consulting engineer is a practicing engineer out of a job."

* * *

Worthy of His Hire

"In his home precinct of Cunningham 34 votes were cast for J. M. Moorman for Adams county engineer. Guy Sturman was elected in 1922, but resigned a year ago and was appointed construction engineer. This created a vacancy which was ignored except by Mr. Moorman's friends.

"Mr. Moorman is a farmer, but if he gives bond and appears for service he will have to be compensated by the county. No provision was made in the 1925 budget for salary of a county engineer, but regardless of this the county would have to meet the salary of the office, which is $1,500 a year."—Dispatch from Ritzville, Wash., in the Spokane *Spokesman-Review*.

* * *

The Stool Pigeon

BY ELLDEE

All day we roost upon a stool and wield the pencil and the rule, the T-square or the pen and ink until our eyes are on the blink, our wings exhausted and our breast worn raw from friction with our vest.

The feathers on our trusty bean are slow but surely turning green—or rather, gray, to be exact—there's naught like sticking to the fact—and showing signs of moulting too; already we have lost a few.

Our knees squeak when we move around, emitting quite a gruesome sound; they're not so limber as they wuz, the reason for which is becuz the years they've spent in status quo has checked the grease's soothing flow.

Spectacles hang upon our bill; and now and then we take a pill or teaspoonful of this or that from out the bottle or the vat, that rests beside the Higgin's ink; which sometimes helps a pain or kink.

It seems we're going on the bum!—But not from women, song and rum. We've plied so long the drafting tools and broken down so many stools, the job at last is breaking us! Soon we'll be ready for the bus!

Still we must stick, and draw and add from early morn till night, Egad! to land the quarter, dime and cent for shirts and skirts and gas and rent and roller skates and spuds and buns, for Screechie and the little ones!

Celebrate Opening of St. Paul Union Station

A public dance in the waiting room of the new Union Station at St. Paul, Minn., on Dec. 6, celebrated the completion of this station, which serves all the railroads entering the city and handles about 150 trains daily. Final work still to be done, which does not affect the use of the station, includes some additional approach tracks, train-heating plant, permanent platforms and sheds and raising the Mississippi River bridge of the Chicago Great Western Ry. about 10 ft., to the new level of the station tracks.

This station, described in *Engineering News-Record*, Jan. 31, 1924, p. 186, is owned by the St. Paul Union Depot Co., of which Col. Frederick Mears is chief engineer. It represents a total cost of about $15,000,000.

Engineering Societies

Calendar

Annual Meetings

NATIONAL DRAINAGE CONGRESS, Chicago, Ill.; Annual Convention, Chicago, Ill., Jan. 5-7, 1925.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, Ill., Jan. 27-29, 1925.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Central Illinois Section of the American Society of Civil Engineers at its meeting Dec. 9 elected the following officers for 1925: President, Frank T. Sheets, Springfield; vice-president, Prof. M. L. Enger, Urbana; secretary-treasurer, Prof. C. C. Wiley, Champaign.

Boston Society of Civil Engineers, Sanitary Section, gave a dinner December 11 at which were present the members of the committee on sewage disposal of the recently formed engineering board of review of the Sanitary District of Chicago.

Louisiana Engineering Society at its Dec. 8 meeting made nominations for the ensuing year and listened to an address by A. R. Losh, district engineer, U. S. Bureau of Public Roads, Fort Worth, Texas, on "A General Discussion of Highway Location."

Personal Notes

J. D. CRAIG, engineer, International Boundary Commission, Department of the Interior, Ottawa, Ont., has been promoted to the position of surveyor-general of Canada, succeeding the late Dr. Deville. Mr. Craig, a graduate of Queen's University, has been for many years in the Department of the Interior and has an extensive experience as a surveyor, having traveled all over Canada and the Arctic archipelago in survey work.

JAMES L. PARKER, formerly special bridge engineer of the South Carolina State Highway Department, announces the opening of an office as consulting engineer at 602 Peoples Bank Building, Charleston, S. C., specializing in steel and reinforced-concrete structures.

EUGENIUS H. OUTERBRIDGE, formerly chairman of the Port of New York Authority and president of the Chamber of Commerce of the State of New York, was recently elected the first honorary member of the Society of Terminal Engineers.

HARLAN D. MILLER, for five years assistant bridge engineer, California State Highway Commission, has been made bridge engineer, succeeding H. E. Warrington, who resigned from that position several months ago. Simultaneously with the announcement of Miller's appointment comes a statement by R. M. Morton, chief engineer of the Commission, placing all bridge work upon state highways under the direction of the bridge engineer in the Sacramento office. Hitherto supervision of the various bridges has been handled from the ten different division offices located in various parts of the state.

J. E. SIRRINE & Co., engineers, Greenville, S. C., announce the opening of a branch office in the Tennessee Electric Power Building, Chattanooga, Tenn., with Fred L. Bryant in charge.

Obituary

HOWARD SOULE, Syracuse, N. Y., in the past widely known for his engineering work on the Erie Canal, died Dec. 10 at his home in Syracuse at the age of 95 years. Mr. Soule was born in Sennett, N. Y., and early became interested in surveying, starting on a short railroad line from Auburn to Ithaca and Lake Ontario. From 1847 to 1853 he was engaged on surveys for draining the Cayuga marshes. In 1854 he became second assistant engineer on the New York State canals but in 1856 went back to railroad construction on the line from Auburn to Lake Ontario and then spent three more years in charge of Cayuga marsh drainage. In 1862 he returned to canal work, making a survey for the gunboat locks on the Erie Canal, middle division, serving from 1863 to 1866 as assistant engineer on the canals and then for six years as resident engineer of the middle division from which he was promoted to be division engineer in 1872. He was appointed in 1874 city engineer of Syracuse and served two years. Mr. Soule then became a contractor and for twelve years was engaged in designing and constructing iron bridges, in constructing about seventy miles of the West Shore R.R., in raising the locks and banks of the Welland Canal in Canada and in lengthening the locks of the Erie Canal. In 1890 he was made consulting and designing engineer for the Skaneateles water-works system for Syracuse, which work he carried for three years and from that time to his retirement in 1902 he was in private practice as a consulting engineer. Mr. Soule had been a member of the American Society of Civil Engineers from 1869 to the time of his death.

COLEMAN MERIWETHER, Louisville, Ky., vice-president and engineer of Meriwether Pressure Pipe Co., died recently at Louisville, aged 49 years. Mr. Meriwether was well known for his work in connection with concrete pipe and concrete pipe joints; his later work included the design of concrete sections for sewers and water-works pipe lines for cities and private corporations. He was at one time president of the Lock Joint Pipe Co. and later was manager of the Cement Products Bureau of the Portland Cement Association, which work he left about six years ago to develop another joint for reinforced-concrete pressure pipe.

WALTER E. HARRINGTON, consulting engineer and banker, resident of Philadelphia with office in New York City, died Dec. 12 at his home in Philadelphia, aged 58 years. Mr. Harrington was a graduate of the University of Pennsylvania and for twenty years thereafter devoted himself to the management of public utilities, especially electric railways. For some years he was operating manager for J. G. White & Co., New York City.

THEODORE E. DUNN, who retired last year at the age of 83 years from active service with the Maine Central R.R., died Dec. 3 at a hospital in Brookline, Mass. After many years' service on railroads in the West, Mr. Dunn was made superintendent of bridges and buildings for the Maine Central in 1897. Subsequently he was promoted to chief engineer and later became assistant to the vice-president and general manager. He was made assistant to the president of the road when it was put under federal control and had remained in that capacity until his retirement. His home was in Dover, N. H.

MAJOR HUBERT S. WYNKOOP, chief engineer of the electrical inspection division of the Department of Water Supply, Gas and Electricity of New York City, died recently at his home in Queens Village, L. I. Major Wynkoop was educated at Stevens Institute of Technology and had worked as an engineer for the Great Northern Ry. and in the South and West before going to New York. He had been for many years with the 23rd Regiment of New York State National Guard.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

To Discuss Problems of Equipment Distribution

Problems involved in the manufacture, sale and service of construction machinery will form the major topics of discussion at the sixth annual meeting of the Associated Equipment Distributors to be held at the Milwaukee Athletic Club, Milwaukee, Jan. 2, 3 and 5. The sessions on the first and last days will be limited to members of the association, which consist of the leading machinery distribution companies of the country. The Jan. 3 session, however, will be a joint gathering of manufacturers and distributors.

Under the chairmanship of William H. Ziegler, the association's president, the closed sessions will be devoted largely to committee reports on trade relations, legislation, catalogs, and contract forms. There will also be addresses on a code of ethics and on the cost of distribution.

RELATIONS WITH MANUFACTURERS

At the open session on Jan. 3, one of the features will be a discussion of methods of promoting better relations between manufacturer and distributor. Among the speakers will be H. E. Smith, president, T. L. Smith Co., Milwaukee; B. E. Yancey, Yancey Bros., Atlanta, Ga.; I. E. Jones, Best Tractor Co., San Leandro, Calif.; and M. R. Hunter, president, Hunter Machinery Co., Milwaukee, and secretary of the association. Another topic which, it is predicted, will evoke lively discussion is "The Repair and Service Problem." The viewpoint of the manufacturer will be expressed by C. W. Pendock, president, LeRoi Co., Milwaukee, while E. D. Townsend, Beckwith Machinery Co., Pittsburgh, will be the distributors' spokesman.

It is planned to consider at this session the formation of a joint committee of manufacturers and distributors for handling problems of mutual concern.

More Balcony Space Available at Road Show

Charles M. Upham, convention manager of the American Road Builders' Association, has just announced that for the Road Show to be held in the Coliseum, Chicago, Jan. 5-9, the Coliseum Co. has assured the completion of the balcony in the new addition to the main exhibit hall, which makes available additional balcony space for exhibition purposes. "This space," Mr. Upham says, "will be especially desirable, inasmuch as the railroad validation will be held in this balcony." The cost will be $1 per square foot and the floor may be loaded to 100 lb. per square foot.

Manufacturers desiring space in this balcony addition are urged to wire Mr. Upham at the Congress Hotel, Chicago.

Year's Engineering Developments Reported by Westinghouse

In a report prepared by H. W. Cope, assistant director of engineering, the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., presents a summary of its engineering achievements during the year 1924. Without getting into electrical and mechanical detail the following notes from the report indicate a few of the outstanding developments of the year.

Generators — Turbines, turbo-generators, synchronous condensers, motor generator sets, rotary converters and transformers are being built in larger and larger sizes, according to the report. New and improved types of drives and control have been devised for the more successful and accurate use of this electrical machinery. During 1924 there were completed and placed in operation the first units of a new line of 1,800-r.p.m. generators consisting of five sizes from 15,000 kw. to 35,000 kw. In addition, two single generator units, having a rating of 62,500 kva., 1,200 r.p.m. each, were placed in operation; they are the largest single generator units yet built. Each rotor for these machines has a net weight of 230,000 lb.

Turbines — The company developed and placed in operation several large sized single flow turbines using a multiple exhaust arrangement of the low pressure blading. The economy of the 10,000 and 12,500-kw. turbines has been considerably improved by modifications made to the frame. Openings have been provided in the castings for the extraction of partially expanded steam for feed water heating. During the year a three-cylinder compound turbine unit with condensing equipment, having a capacity of 52,000 kw., was installed.

Marine Transport — In the field of transportation, the Diesel-electric drive was successfully applied to all manner of ships, from pleasure yachts to oil tankers and harbor tugs. This same sort of drive has also been applied to a self-contained locomotive of a size and capacity not attempted before. Four Diesel electric hopper dredges were built for the U. S. War Department, Corps of Engineers. Each vessel is fitted with the largest Diesel electric plant ever installed on a ship; electric power is used for propulsion, dredging and every other operation on board, including cooking and heating.

Locomotives — A larger number of electric locomotives were placed in service than in any previous year. Almost every type and system are represented from 600 volts, d.c., to 3,000 volts, d.c., as well as single phase, split phase and motor-generator types operating under the 11,000-volt single phase trolley. During the year the company placed in service 235 main line electric locomotives; of this number 120 went to the Paris & Orleans Railway in France, 39 to the Chilean State Railway, 36 to the Virginian Railway and 12 to the New York, New Haven & Hartford. Working in co-operation with the Baldwin Locomotive Works, the Westinghouse company is constructing a 1,000-hp. Diesel-electric locomotive to weigh approximately 125 tons. It is probable, says the report, that this size locomotive will be widely applied for heavy switching service for branch lines and even for main line duty.

Other accomplishments during the year included an accurate method of balancing rotating machinery which can be operated by almost anyone.

Elevators—In the building equipment field, electric elevators have been developed to a point where speeds of 1,000 ft. per minute are entirely possible. In fact, says the report, there seems to be no reason why speeds cannot be increased up to the limit prescribed by the speed at which human beings can be transported vertically without discomfort. During the year the company built a special tower for testing elevators.

Lighting — The year saw the introduction, in the street lighting field, of a successful and practical asymmetrical distribution of light. This is accomplished by the Bi-lux refractor which divides the light flux into two wide beams diverging in opposite directions up and down the street (see *Engineering News-Record*, Dec. 11, page 974). The tendency for higher mountings for the light source has led to the development of taller posts; designs are now offered providing for a maximum of from 16 to 22 ft. to the light center.

In the field of highway lighting, the company has developed a dust-proof unit for mounting on wood poles 200 to 400 ft. apart and at a height of 25 ft. The unit comprises a Mazda lamp, parabolic reflector and double set of refracting prisms. The light is directed up and down the highway in two long, narrow beams.

Business Notes

ARCHER IRON WORKS, Chicago, have appointed A. L. Tucker as exclusive sales representative. Mr. Tucker was formerly Chicago sales manager for the Ransome Concrete Machinery Co. of Dunellen, N. J.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., announces appointments involving four division sales managers as follows: W. R. Stinemetz, heavy traction division, and K. A. Simmon, light traction division, have been appointed assistants to M. B. Lambert, manager of the railway department. To fill their places, A. J. Manson, transportation division, New York, has been promoted to the managership of the

heavy traffic division, and E. A. Palmer, transportation division, San Francisco, to the managership of the light traction division.

EASTERN PAVING BRICK MANUFACTURERS ASSOCIATION, at its annual meeting held in New York City Dec. 9, elected the following officers: President, R. L. Winslow, New York; vice-presidents, W. W. Cunningham, Pittsburgh, F. L. Stowell, Olean, N. Y., C. C. Blair, Canton, Ohio, and J. W. Hall, Baltimore; treasurer, R. T. Hutchins, Wilkes-Barre, Pa.; secretary, William C. Perkins, Philadelphia; governor, C. P. McFadden, Toronto, Ohio; alternate, D. R. Potter, Clarksburg, W. Va.

Equipment and Materials

New Diesel Power Shovel

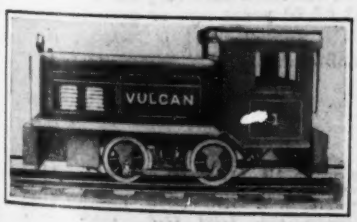
To its line of power driven excavators the Pawling & Harnischfeger Co., Milwaukee, has just added a revolving shovel equipped with a Diesel engine.

The new machine has a 1-cu.yd. dipper (struck measure) or may be equipped with a 1-cu.yd. dragline or clamshell bucket operating on a 40-ft. boom.

The engine is of the mechanical injection type burning a cheap grade of fuel oil. The crank shaft, wrist-pins and bearings, the manufacturer points out, are of extra heavy construction. The speed is low, reducing vibration to a minimum.

7-Ton Gasoline Locomotive Has Worm Gear Drive

Equipped with a worm gear drive a new 7-ton gasoline locomotive has been produced by the Vulcan Iron Works, Wilkes-Barre, Pa. A feature of this equipment is the cast steel bar type of frames and forged steel side connecting rods, as in steam locomotive practice. The drive and reversing mechanism is mounted as a unit in a cast-steel, oil-tight and dust-proof housing, made in halves and placed in the center of the rear axles, permitting quick and easy dismantling or assembly.



The transmission is of the four-speed, selective gear type. Speed changes are made by the engagement of jaw clutches, the gears being in constant mesh. The transmission case is entirely inclosed.

The locomotive under normal conditions has the following rated drawbar pulls at the speeds noted: 4,200 lb. at 2 miles per hour; 3,500 lb. at 4½ miles per hour; 2,500 lb. at 7½ miles per hour; 1,725 lb. at 10½ miles per hour.

The power equipment of the locomotive is a Waukesha 60-hp. gasoline engine with Splitdorf magneto, Westinghouse self-starter and electric lights, Stromberg carburetor, and Willard storage battery. The radiator is of the tubular type, well protected.

Preservatives for Metal and Masonry Surfaces

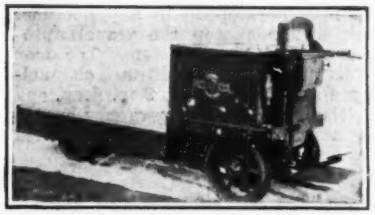
To prevent the rusting of steel and other metals used in construction, the Arabol Manufacturing Co., New York, is producing a transparent liquid preservative called Metalol, which forms a tough, elastic, invisible skin on the surface to which it is applied, ordinarily with a brush. This coating is claimed to be proof against rust, acid, salt water and steam, and is applicable to structural steel in bridges and buildings, tanks, pipe lines, street lighting fixtures, sprinkler systems in industrial buildings and similar uses. The material requires from 2 to 3 hr. to dry. On metal not exposed out of doors one coat is usually sufficient, but under conditions of exposure to rain, sea water or salt air, from two to three coats are recommended.

For the protection of wood, stone, marble, brick or concrete surfaces, the company offers another preservative called Lithol. This is recommended for flooring, railroad ties, fence posts, telegraph poles, piles, marine woodwork, and all kinds of masonry structures. The material, the manufacturer explains, prevents disintegration by filling the pores of the surface treated without changing its outward appearance. On concrete and stone floors it is claimed to prevent dusting. Lithol may be applied with a mop, a soft brush or by dipping.

Electric Truck Has New Features

The latest addition to the line of electric trucks manufactured by the Crescent Truck Co., Lebanon, Pa., is a special elevating platform model which has a height of 17½ in. from the floor when the platform is down and 22 in. when the platform is raised. The main difference between this truck and former models using a 12-in. platform is that the rear wheels are 15 in. in diameter, giving a 6-in. clearance underneath the platform. The tires on the new model are 5 in. wide and the truck is constructed throughout for heavy service, with a lifting capacity of 3 tons.

Wheels are equipped with Timken roller bearings and the driving unit is carried on S K F ball bearings. The



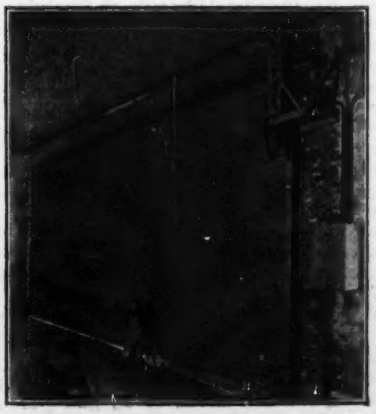
controllers are built by the Cutler-Hammer Co. and the motors by the General Electric Co. The loading platform of the truck is 70 in. long and 26 in. wide.

Largest Rolling Door

What is claimed to be the widest rolling steel door ever made has been installed by the Cornell Iron Works, Inc., New York, at the plant of Kirkman & Sons, soap manufacturers, Brooklyn. The masonry opening is 45 ft. wide and 17 ft. high, forming a railway track entrance into the building. The unusual width is required for the switching in of cars at a sharp angle. The door weighs 2 tons and is operated up and down by electric motor in 30 sec. Con-

crete loading platforms within the building necessitated a rolling instead of a swinging door.

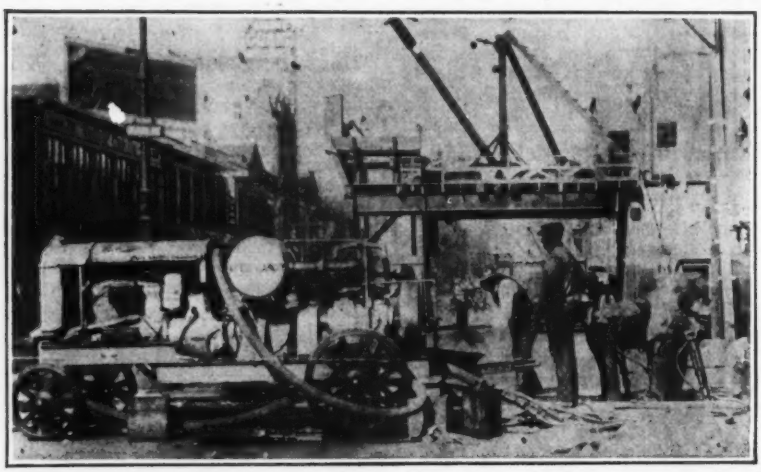
The door proper is constructed of No. 16 gage galvanized interlocking steel slats which, during the process of raising or lowering, coil around an overhead horizontal shaft 47 ft. between supporting brackets. Twelve heavy helical springs counterbalance the weight of the door. The drive is by a 7½-hp. motor through a train of spur gears. The control is by a set of push buttons on either jamb by which the



door may be stopped in any position. Limit switches stop the travel automatically at top and bottom. The door travels in heavy built-up channel-shaped steel side guides 9 in. deep, one on either jamb. For emergency operation a sprocket and hand chain are provided.

Portable Air Compressor Has Fordson Power Unit

For road-building and general contractors, iron and steel erectors, city engineers, water and gas companies, quarries, bridge builders and state and county highway departments a portable air compressor utilizing the Fordson tractor as a power unit has been announced by the Metalweld Service Corporation, Philadelphia. The unit is assembled on an all-welded steel I-beam frame mounted on steel axles and wheels making the unit portable.



The Fordson engine drives the compressor through a 2-in. chrome-vanadium steel shaft which extends from the rear end of the tractor transmission to which is fitted a cast-iron cut gear. This gear engages with a steel-face, rawhide gear which drives the compressor, thus practically eliminating vibration and assuring long life to the compressor and quiet operation. The gears are encased with an oil-tight guard and continually run in grease.

The compressor is a standard 6x6-in. duplex Gardner Rix high speed compressor delivering 118 cu.ft. of free air per minute at 100 lb. pressure. It is lubricated by an oil pump and splash system which insures lubrication to all parts of the machine. There are no grease cups on either the Fordson tractor or the air compressor, the entire oiling system being automatic. When delivering 118 cu.ft. of air the engine runs in second gear. If this much air is not required the Fordson can be run in low gear, making its operation more economical for low air capacity.

An automatic unloader on the compressor cuts off the suction when the pressure in the tank reaches the set pressure. An automatic governor runs the engine at 1,000 r.p.m. Gasoline consumption is from 1 to 1½ gal. per hour. Water taken from the tractor is circulated through the compressor by a bronze water pump and delivered back to the radiator.

Publications from the Construction Industry

Pipe-Threading Equipment — OSTER MANUFACTURING CO., Cleveland, manufacturer of pipe-threading equipment, describes its products in a 55-p. illustrated booklet. The line includes die stocks, light hand machines with ratchet and power-driven units. The data include shipping weights, dimensions, speeds and other characteristics of the power machine and a table of pipe and fittings specifications.

Swimming Pools—GRAVER CORP., East Chicago, Ind., has published a 20-p. pamphlet entitled "Water Supply for Swimming Pools," including data on design, construction and operation. The text indicates the proper applications of the company's filtration and swimming pool accessory equipment.

Alumina Cement — ATLAS LUMNITE CEMENT CO., New York, in a 31-p. illustrated pamphlet, describes properties and uses of Lumnite cement, which requires only 24 hr., as compared with 28 days for other cements, to obtain full strength. Alumina cement of this type has been on the European market, principally in France, for more than 10 years. The high early strength of this cement, its manufacturer points out, adapts it particularly to any construction work where speed is essential, and where business activities, industrial plant operation, street or highway traffic cannot long be interrupted. The cement also can be used in much colder weather than other building cement. For highway and other work, concrete made of Lumnite cement may be placed in service 24 hr. after completion. The pamphlet contains the results of laboratory tests of this cement and indicates a number of applications both in text and photographs.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Few Records Kept of Labor Productivity and Cost

Report of Dept. of Labor Shows Unit Costs In Bricklaying, Plastering, Painting and Roofing

We quite frequently hear the "comparative inefficiency of labor" alluded to, particularly in connection with skilled building trades mechanics. It is evident that few records are being, or have been kept concerning the man-hour performance of labor in various industrial operations.

The investigation of the subject started last year by the U. S. Bureau of Labor Statistics, reveals some interesting facts relative to the cost per unit of building labor.

Ethelbert Stewart, U. S. Commissioner of Labor Statistics, in his report on labor productivity and costs in certain building trades, as published in the November *Monthly Labor Review*, states that "notwithstanding the persistence of articles and interviews in newspapers and trade journals about the relative inefficiency of labor as compared with former years, this bureau was unable to find a single building contractor, superintendent or foreman who had a record of work done per man-hour on the jobs in progress or upon any former job. It was necessary, therefore, for the agents of the bureau to locate building projects just begun or just about to begin and then to make arrangements with the responsible contractor to have the actual time of the men kept for the purposes of this report, and not only that but to follow up each job day by day to see that the record was being kept."

Bricklaying—"The instruction to the agent was to secure the bricklayer time and labor cost per 1,000 common bricks laid in a straightaway wall without opening. This would seem to be a simple matter, but it was found that brick houses, so common a generation ago, are very difficult to find. Structures of hollow tile, of cement and framework, and of steel are being faced with 'face brick,' but obviously these are so particularized in their plans, particularly as to the brick finishing part, that this work can not be considered as ordinary bricklaying; and solid brick walls are very difficult to locate. In other words, the bricklaying to-day is for the most part very different from that of 20 years ago or even 15 years ago."

LABOR PRODUCTIVITY AND COST IN BRICKLAYING

	Average Pay Per Hr.	Number Laid Per Hr.	Number Laid Per 8-Hr. Day	Cost of Laying 1,000 Brick
Birmingham, Ala.	$1.16	241.0	1,928.0	$4.82
New Orleans, La.	1.01	203.5	1,628.0	5.11
New York, N. Y.	1.76	157.6	1,260.8	11.69
Indianapolis, Ind.	1.36¼	95.7	765.6	14.47

Plastering—"The net area per man-hour as between union and non-union plasterers did not vary greatly in the same locality. Twelve schedules taken from union firms in Atlanta give a net area output per man-hour of 5 sq.yd. Seven non-union jobs have an average of 5½ sq.yd. The non-union plasterer's cost per sq.yd. was 19c. and the union plasterer's cost, 25c. per sq.yd."

LABOR PRODUCTIVITY AND COST IN PLASTERING

	Rate of Pay Per Hr.	Sq.Yd. Plastered (Net Area) Per Hr.	Per 8-Hr. Day	Cost Per Sq.Yd. (Net) Area)
Birmingham, Ala.	$0.957	5.9	47.1	$0.17
Boston, Mass.	1.438	4.5	36.3	0.33
New York, N. Y.	1.875	5.4	43.4	39
Philadelphia, Pa.	1.643	7.8	62.4	21

Painting — This operation is shown for four cities only. "Five schedules on three-coat work were obtained in Atlanta and four schedules on three-coat work were obtained in New Orleans. For the other two cities data are shown for two-coat work."

LABOR PRODUCTIVITY AND COST IN PAINTING

	Num. of Coats	Rate of Pay Per Hr.	Number of Squares Painted Per Hr.	Per 8-Hr. Day	Cost Per Square
Atlanta, Ga.	3	$0.68	0.34	2.72	$2.29
Birmingham, Ala.	2	.63	0.57	4.56	1.12
Chattanooga, Tenn.	2	.75	0.48	3.84	1.57
New Orleans, La.	3	.83	0.25	2.00	3.84

Roofing—"Shingles are constructed with a view to attaching them to the roof with a certain number of nails, and while some workmen put in the full number specified, there are others who put in only one nail to the shingle."

LABOR PRODUCTIVITY AND COST IN ROOFING

	Rate of Pay Per Hr.	Number of Squares Covered Per Hr.	Per 8-Hr. Day	Cost Per Square
Birmingham, Ala.	$1.00	1.00	8.00	$1.00
Chattanooga, Tenn.	.68	0.31	2.48	2.21
New York, N. Y.	1.15	0.49	3.92	2.72
Cincinnati, O.	.89	0.33	2.64	2.81

Large Projects in Prospect

(See Construction News pp. 321 to 331)

Proposed

University group, Chicago, Ill., preparing plans, $10,000,000.

Pier, Baltimore, Md., preparing plans, $5,000,000.

Hotel, Atlantic City, N. J., proposed, $5,000,000.

Saw mills, Longview, Wash., proposed, $3,000,000 to $5,000,000.

Bridge, Chicago, Ill., preparing plans, $2,650,000.

Industrial exposition, preparing plans, $2 000,000.

Sillery, Que., Canada, proposed, $2 000,000.

Schools, St. Paul, Minn., proposed, $1,500,000.

Courthouse and jail, San Antonio, Tex., proposed, $1,500,000.

(*Continued on p.* 1018)

Business Briefs

Call money easy at 3 per cent, Dec. 15.

Time loans firm at 3¼ for 60 to 90 days; longer periods 3¾ per cent.

Commercial paper, best names, 4 and 6 mo., 3¼@3¾; others, 4 per cent.

Slow-Down in Borrowing for Municipal Improvements

State and municipal bond sales for the entire country, during November, amounted to $68,117,359 according to *The Commercial and Financial Chronicle*. October issues aggregated $88,185,346 and those for November, 1923 totaled $98,521,514.

The November disposals were heavier than those for the corresponding month in 1920 or 1922 but considerably under the total for November, 1921.

The largest single offering was a North Carolina, $15,000,000 highway bond, purchased by B. J. Van Ingen & Co. and others, of New York, at par for 4½s. The state of Minnesota sold $5,000,000 rural credits bonds to Dillon, Read & Co. and others, of New York, at 100.52 for 4½s, a yield of about 4.20 per cent. The state of Missouri awarded $6,000,000 4 per cent road bonds to the National City Bank of New York at 98.15, a basis of about 4.20 per cent.

The majority of the November issues were 5s and considerable above par. Most of those bearing low interest rates were in Middle Atlantic states.

REPRESENTATIVE PUBLIC BOND SALES DURING NOVEMBER, 1924

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
California	Harbor improvement	$2,000,000	4	98.85	4.19	July 2, 1915	1989	Calif. Nat'l. Bank and others
County								
Bergen, N. J.	Public improvement	1,429,000	4½	101.43	4.34	Dec. 1, 1924	1925—46	Graham, Parsons & Co. of Phila. and others
Crooked Creek Drainage Dist., S. C.	Drainage	21,000	6	97.50			1930—50	Planters' Nat'l Bank of Bennettsville
Cumberland, N. J.	Road improvement	250,555	4½	101.03	4.33		1925—44	Bankers' Trust Co. of Atlantic City
Cumberland, N. C.	Court house	300,000	4½	100.68	4.70	Apr. 1, 1924	1929—53	Seasongood & Mayer of Cincinnati
Dodge, Wis.	Highway	305,500	5	104.84	4.34	Apr. 1, 1924	1927—44	Morris F. Fox & Co. of Milwaukee
Falls, Tex.	Road	115,000	5½	98.50	5.67	June 1, 1924	1925—54	Brown-Crummer Co. of Dallas
Jackson, Ind.	Highway	4,800	5	103.69	4.24	Dec. 1, 1924	1924—35	J. F. Wild & Co. of Indianapolis
Lake, Ind.	Bridge	125,000	5	103.02	4.37	July 1, 1924	1925—35	Commercial Bank of Crown Point
Laporte, Ind.	Roads	104,385	5	103.76	4.23	Nov. 25, 1924	1926—35	J. F. Wild & Co. of Indianapolis
Orleans, N. Y.	Highway improvement	56,000	4½	100.97	4.10	Nov. 1, 1924	1932	Bonbright & Co. of New York
Paulding, O.	Road	108,209	5	102.08	4.53	Dec. 1, 1924	1926—32	Prudden & Co. of Toledo
Township								
Assumption Parish Drainage Dist. No. 2, La.	Drainage	100,000	6	103.25	....	Sept. 1, 1924	1926—65	Whitney-Central Trust & Savings Bank of New Orleans
Jackson Tioga Co., Pa.	Improvement	40,000	4½	102.88	4.48	Nov. 1, 1924	1930—50	Merchants Bank of Elmira
Municipal								
Amite City, La.	Sewer	65,000	6	102.16	5.76	Oct. 1, 1924	1925—46	Amite Bank & Trust Co.
Astoria, Ore.	Municipal improvement	70,000	6	102	5.74	Nov. 1, 1924	1926—44	Lumbermen's Trust Co., of Portland
Atlanta, Ga.	Street improvement	173,500	4½	101.03	4.29	Dec. 1, 1924	1927—33	Harris, Forbes & Co.
Beckley, W. Va.	Street and sewer	100,000	5½	106.02	5.02	July 1, 1924	1925—54	A. E. Aub & Co. and others of Cincinnati
Boonton, N. J.	Street improvements, etc	72,466	4½	102.06	4.45	Nov. 1, 1924	1926—39	Geo. B. Gibbons & Co. of New York
Central City, Ky.	City improvements	100,000	5	100	....	Jan. 1, 1925	1926—45	Weil, Roth and Irving of Cincinnati
Centralia, Mo.	Paving	42,000	5	104.90	....		20 yr.	Harris Trust & Savings Bank of Chicago
Clearwater, Fla.	Street improvements	24,000	5½	104.13	....		30 yr.	People's Bank of Clearwater
Davidson, N. C.	Water	80,000	5½	101.70	5.61	July 1, 1924	1926—65	Drake, Jones & Co.
Elmira, N. Y.	Paving	50,000	4½	100.59	4.11	Dec. 15, 1924	1925—34	Harris, Forbes & Co. of New York
Evansville, Ind.	Hospital	150,000	4½	103.38	....		20 yr.	Nat'l City Bank of Evansville
Freeman Creek, W. Va.	Road	225,000	5	100.01	4.99	July 1, 1923	1929—34	Prudden & Co. of Toledo
Garibaldi, Ore.	Water	25,000	6	100.75	5.98	Nov. 1, 1924	1927—41	Hattrem, Nelson & Co. of Portland
Griffith, Ind.	Drain	12,500	5	100.24	4.90	June 10, 1924	1925—30	Thompson, Kent and Grace of Chicago
Harriman, Tenn.	Municipal improvement	140,000	5½	103.02	5.26	Dec. 1, 1924	1934—57	Hanchett Bond Co. of Chicago
Hillsboro, O.	Street improvement	8,600	5½	103.73	4.72	Sept. 1, 1924	1925—34	Herrick Co. of Cleveland
Kansas City, Kan.	Improvement	320,893	4½	101.12	4.27	Nov. 1, 1924	1925—34	Prudential Trust Co. of Topeka
Lexington, N. C.	Street and other improvements	125,000	5½	101.36	6.12	Oct. 1, 1924	1925—62	Mercantile Trust Co. of St. Louis and others
Mansfield, O.	Storm sewer	11,000	5½	102.73	4.97	May 1, 1924	1925—36	Richland Savings Bank of Mansfield
Martins Ferry, O.	Water and light	400,000	5	100.12	4.97	Oct. 1, 1924	1926—44	Stranahan, Harris and Oatis of Toledo
Muskegon Heights, Mich.	City improvement	15,000	4½	100.49	4.65	June 2, 1924	1925—34	Paine, Webber & Co. of Chicago
Painesville, O.	Electric lights	16,000	5	102.27	4.60	Apr. 1, 1924	1929—32	Herrick Co. of Cleveland
Paterson, N. J.	General improvement	296,000	4½	101.58	4.35	Dec. 1, 1924	1925—52	Hamilton Trust Co. of Paterson
Philadelphia, Pa.	Public improvement	3,000,000	4	102.29	3.88	Dec. 1, 1924	1954	City Sinking Fund Comm.
Piedmont, Calif.	Municipal improvement	84,500	5	107.83	....		....	Blyth, Witter & Co. of San Francisco
Pittsburg, Kan.	Improvement	27,222	4½	100.11	4.23	Aug. 1, 1924	1925—38	Prudential Trust Co. of Topeka
Rocky River, O.	Road improvement	4,650	5½	102.38	4.95	Oct. 1, 1924	1925—34	Milliken & York Co. of Cleveland
Rye, N. Y.	Road reconstruction	100,000	4½	100.27	4.20	Mar. 10, 1924	1925—44	Rutter & Co. of New York
San Diego, Calif.	Pier and bulkhead	475,000	5	104.76	4.60	Jan. 1, 1925	1925—61	Anglo-London-Paris Bank of San Francisco
Schaghticoke, N. Y.	Water-works	60,000	5	106.38	4.37	Nov. 15, 1924	1925—54	The Union National Corp. of New York
Waltham, Mass.	Street	14,000	4	100.29	....	Oct. 1, 1924	1925—34	Estabrook & Co. of Boston

Large Projects in Prospect

(*Concluded from p. 1017*)

Draining and flood protection, 75,000 acres, Princeton, Ind., takes bid in Spring, $1,250,000.

Hotel, New York, N. Y., preparing plans, $1,200,000.

Bids Wanted on Big Jobs

Foundation, Chicago, Ill., Mundie & Jensen, archts. and engrs., $1,500,000.

Apartment, Boston, Mass., for Three Hundred Ninety Beacon St., Inc., $1,500,000.

Paving, 46-in., Floresville, Tex., County Commrs., $1,000,000.

Store, Bridgeport, Conn., D. M. Read Co., $1,000,000.

This Week's Large Contracts

Canal, section of Welland Ship Canal, St. Catherines, Ont., awarded to Canadian Dredging Co., Midland, $10,000,000.

Blast furnace, Massillon, O., steel work to Riter-Conley Co., Pittsburgh, $5,000,000.

Office and warehouse, New York, N. Y., to Starrett Bros., $4,000,000.

Pulp and paper mill, St. Joseph D'Alma, Que., to Dominion Bridge Co., Ltd., Lachine, $2,000,000.

Theatre and office, Detroit, Mich., to Longacre Eng. & Constr. Co., N. Y. C., $2,000,000.

Office building, Ft. Worth, Tex., to Bellows & McClay, $1,250,000.

Dredging, Houston, Tex., to Atlantic Gulf & Pacific Dredging Co., Galveston and S. A. Lacey, $1,000,000.

Bakery, Detroit, Mich., to Everett Winters Co., $1,000,000.

Theater and arcade, Akron, O., to Carmichael Constr. Co., $1,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 4, the next, on January 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	+$4.25
Structural rivets, 100 lb.	3.75	4.35	4.75	+3.75	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	2.60	3.25	3.97½	3.35	3.25	+4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.45%	36%	44.7@55.5%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	55.60@56.60	56.00	+56.00	+47.20@48.20	55.50	+64.00	55.00	65.00	—60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd.	2.00	1.90	2.38	+2.75@3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	+2.75@3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	+2.75@3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+58.00	34.00	57.20	55.00	39.75	36.75	29.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.50@3 00	1.45	1.85	1.50	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	12 10	12.00	15.00	12.00	14.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.14	+1.21	+1.25	+1.10	+1.22	+1.31	1.18	1.12	—1.11
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	—30@.50	.75	.50@.55	.35@.50	.50	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.375. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

The upward trend in construction materials prices, started a month ago, is strongly in evidence in this week's market.

Steel bars, shapes, plates and wire products are particularly firm. Cast-iron pipe prices advanced during the week in several large cities of the West and Southwest.

Long-leaf yellow pine timbers are up $3 per M. ft., b.m., in the New York market. The general improvement in demand has extended to flooring, special cutting, roofers, boards and short-leaf dimension lumber.

Freezing weather has developed price firmness in concrete aggregates and common brick. The low temperature has affected brick prices only in the Northern districts where plants have shut down, leaving limited reserve stocks in the face of an increasing winter demand.

Linseed oil, the paint barometer, is rising again owing to higher flaxseed prices. Increases of 3 to 8c. per gal. are reported in various large cities throughout the country.

A small surplus of common laborers is reported in the Dallas district, with a consequent reduction in the wage rate of about 10c. per hr., making the present schedule, 30@50c. as against 30@60c. per hr. Bricklayers' wages dropped 20c. per hr. in Montreal. The present level is 80c. per hr., against $1, formerly.

The steady gain in steel demand since July has culminated in a total of 4,031,969 tons in unfilled orders on books of the U. S. Steel Corporation as of Nov. 30, 1924. The bookings on Oct. 31 were 3,525,270 tons, with 4,368,584 tons on Nov. 30, 1923.

At the same time, however, cement production for the entire country dropped 13 per cent and with a 41 per cent decrease in shipments, the reserve mill stocks for the nation advanced 50 per cent during the month ending Nov. 30, 1924.

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